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ELECTRIC LIGHTING FOR SHIPS.

WE have many times had occasion to remark upon the slow progress being made in the adaptation of the electric light to useful purposes in this country. Particularly is this tardy movement noticeable in regard to domestic illumination by means of incandescence lamps. The reasons for this are now pretty generally known; but at present there seems very little prospect of a speedy or adequate change in the circumstances which have served to place electric lighting in the somewhat false position in which it now has, perforce, to stand, and, therefore, any field offering more favourable opportunities to contractors for the disposal of their apparatus should be energetically followed.

It will not have escaped observation that of late much good, and probably remunerative, work has been done in several quarters in the electric lighting of ships; and, indeed, it appears to be chiefly in this direction that electric light companies must look for employment for some time to come. A few companies only originally laid themselves out for this kind of work; but the success which has attended the efforts of Messrs. Siemens Brothers and the Swan and Edison Companies, has encouraged others to follow in their wake, with results which, if varying, have nevertheless afforded substantially correct indications of what is possible in this branch of the industry.

As an instance of what may be accomplished by scientific labour, liberally and earnestly encouraged by careful and competent management, we may point to the latest achievements of the Anglo-American Brush Electric Light Corporation. Until recently this company confined its operations almost entirely to arc lighting. When fully recognising the importance of ship lighting, the company set diligently to work, apparently determined to overcome all obstacles, and the result is, as may be seen from our last week's issue, that it has succeeded in establishing itself in a prominent position amongst those companies which have hitherto held the foremost places.

It is a gratifying sign that, after a thorough inspection of the system in vogue on five of the ships at Portsmouth, the Lords of the Admiralty should have expressed themselves so greatly in favour of the electric light for use in the Royal Navy. The installations on the *Colossus* and the four other ships visited last week may be looked upon as greatly serving the purpose of tests, upon the result of which future practice in regard to ship illumination will depend; and therefore it is in an eminent degree satisfactory that their lordships have recognised the immense superiority of the light to any other means hitherto adopted. This should afford encouragement to, and inspire confidence on the part of the few still solvent companies left to do the work which quite evidently is opening out before them. That the extent of the field is enormous can scarcely be doubted; for outside of the Navy, in the case of vessels belonging to steamship companies and private firms upon which installations have been carried out, the most lively satisfaction appears to be derived alike by owners, officers and passengers; and it can hardly be otherwise than that the approval so unhesitatingly passed in these instances will lead to the eventual adoption of electrical illumination by rival companies and by the shipping community generally.

To us it is a matter of little import whether the lighting be carried out by means of Victoria, Edison, Siemens or other dynamos; there is ample room for all. But we do desire to see the extension of ship electric lighting, believing that unqualified success in this direction will increase the confidence of the public, and thus open up other paths, either new or at present partially closed, for the development of the electrical industry.

ELECTRIC LIGHTING CONSIDERED FROM A SANITARY POINT OF VIEW.*

By J. ANGELO FAHIE, C.E.

THE author hopes to be able to show that the question of artificial lighting, and especially electric lighting, has a most important bearing on sanitation, although hitherto it has not received very serious attention from this point of view. When we reflect what a considerable portion of time is spent by modern society under light other than natural light, and how much more injurious are all modes of artificial lighting in comparison with sun-light it is essential that we should anxiously consider the most desirable form of light which shall exercise the least ill effects on our bodily health and comfort.

Since the object of this paper is to consider the subject of electric lighting from a sanitary point of view, and since it was only with the general introduction of gas and petroleum the danger of injury to health arose, it is not necessary to dwell on the forms of lighting in vogue prior to the illuminants now so universally used.

The conditions of life under all kinds of artificial light are less favourable to health than under daylight. Under artificial light these conditions are completely altered; light which would be considered excessive at night is far inferior to ordinary daylight. The heat produced by all forms of light exceeds the temperature of the atmosphere in average daylight, and the air is vitiated to an extent proportional to the amount of light produced. How desirable, therefore, is it that we should seek, and by every effort in our power assist in, the development of that form of artificial light which approaches nearest the conditions existing under sunlight.

As will be seen hereafter, the light afforded by means of electricity is far superior to all other illuminants in the fulfilment of these conditions.

Gas, for example, the chief constituent of which is a combination of carbon and hydrogen, will not burn without the aid of the oxygen in the atmosphere. In the process of combustion the particles of carbon contained in the gas come into contact with the oxygen of the air, and float in an incandescent state in the interior of the burning vapour, and this constitutes the flame. The presence of the carbon in a finely-divided state may be easily shown by holding some refractory substance in the flame, when the carbon will be deposited upon it in the form of soot.

Should, however, the supply of oxygen be insufficient, partial combustion only takes place, the carbon escaping in an unburnt condition in the form of a dark cloud, when the flame is said to smoke.

The brightness of the flame therefore depends on the supply of air necessary for perfect combustion.

The light afforded by candles and lamps does not differ essentially from that of the ordinary gas burner. The same elements which constitute the one are present in the other—they all owe their luminosity to combustion. A petroleum lamp burns

* Abstract of a paper read at the Congress of the Sanitary Institute of Great Britain held in Dublin this month.

imperfectly without a chimney, but when this is put on, a strong draft is caused, supplying the air necessary for thorough combustion, and the brilliancy of the flame is thus materially exalted.

From what has been said it is obvious that in order to obtain the highest illuminating power of a flame, a plentiful—and what is more, a fresh—supply of air is essential. Moreover, in the process of combustion the air is contaminated with certain poisonous compounds, such as carbonic acid, carbonic oxide, and sulphur, which, when breathed even in a limited quantity, are injurious to the human frame. Another effect of combustion is the production of vapour, formed by the oxygen of the air combining with the hydrogen, which constitutes a portion of the material consumed.

As has been already pointed out, gas not only deprives the air of its health-giving oxygen, but it contaminates it with poisonous compounds which are more or less—according to the extent to which they exist—injurious to animal life. Dr. Tidy considers that the contamination of the atmosphere in a crowded theatre at the end of the performance may be regarded as distressing, and many of us experience disinclination to go to the theatre because of the inconvenience suffered from the heat and vitiation of the air caused by the gas, producing headache and, oftentimes, giddiness. The effects of heat and vapour from combustion will be readily detected in a wareroom or shop, the lower portion of which may be only at a temperature of 60° to 70°, in consequence of the hot air ascending, the temperature near the ceiling will probably be from 130° to 140°. When, therefore, goods, books, &c., are placed in such high localities it cannot be wondered at that they become injured or destroyed. Indeed, referring to the amount of water generated by the gas flame, it is stated on authority that sixty gas jets will produce on the lowest computation two gallons of water per hour! Thus it is we often see on a December evening streams of water trickling down the windows of shops brilliantly lighted by gas.

Electric lighting by incandescence produces absolutely none of the evil effects just enumerated. There is no oxygen consumed, no carbonic acid or other compounds given off, and, consequently, there is no vitiation whatever of the atmosphere; and, as to the heat-producing effects, the air of a room lighted by gas is twenty times more heated than if lighted by incandescent electric lamps. From this it will be readily seen how conducive to health and bodily comfort are the conditions fulfilled by electric light in contrast with all other illuminants. And not only is the health and bodily comfort affected by the influence of artificial light, but the temperament also; and it is very remarkable to notice the difference in the effect produced by gas light, and electric light, on the spirits of those obliged to work long hours at night. A brilliant light, we all know, exercises a cheerful influence on the animal spirits, and electric lighting affords unusual facilities for acquiring a higher degree of illumination without the accompanying heating and air-vitiating evils inseparable from gas and petroleum.

The glare of the electric light is commented on as being objectionable; but this is only applicable to the arc light, and even this form readily admits of being shielded in ground globes; and as it is only suitable for outdoor use and for large buildings, it is not necessary here to say much about it. A strange story was told in the newspapers a few days ago, of a boy, aged about 14 years, who, for a wager, stared at the sun for some time and died the same night in great agony. Professor Pickering, a German *savant*, recently made an investigation into the cause of weak sight amongst the students of his university, and traced it to the heat given off by their reading lamps, which dried up the humours of the eye. Seeing that the electric light gives off but a trifling degree of heat, it is, therefore, far preferable in this respect, and far less injurious to the sight than gas, oil, or candle light.

Many institutions throughout the country are now lighted by electricity, and in every single instance with the most beneficial results to the health and comfort of the people who work by its aid.

It would be impossible in a small space to describe the lighting arrangements in these institutions, but the author may be permitted to refer to one installation which has been working under his charge for the past nine months, and which will serve as an illustration for many others. The installation referred to is that of the offices of the *Irish Times*. The composing room here forms one large appartment measuring some 60 by 70 by 40 feet in height. Before the introduction of the electric light, this apartment was lighted by 100 gas jets, and, remembering that one gas jet consumes as much oxygen as five individuals, and adding to this the effects resulting from the breathing of the compositors, together with the long hours of night during which the work is carried on, we can readily conceive how extremely unwholesome and unhealthy must have been the air of this apartment. Indeed, as a matter of fact, the employés frequently suffered from ill health and discomfort, which they usually attributed to the vitiated state of the atmosphere, and it was not unusual to have several out on sick leave at one time. This was especially noticeable in summer. The temperature of the apartment frequently ran as high as 85° in winter, and 95° in summer. The discomfort occasioned sometimes in summer was very serious indeed, oftentimes rendering it impossible for some of the men to carry on their business for the usual number of working hours.

Since the introduction of the electric light the condition of things is entirely changed. The atmosphere is pure and healthy, the thermometer rarely marks higher than 70° during the night, the light is bright and perfectly steady in its action, the health of the employés is good, and their spirits cheerful and buoyant, many of them being able to work for considerably longer hours now than formerly, and the sick list has all but disappeared.

This proves that not only from a sanitary, but also from a *commercial* point of view is the introduction of the electric light beneficial.

It may be argued that a proper system of ventilation would render the use of gas harmless; but the question of ventilation, although apparently so simple, is difficult to deal with. With the electric light the difficulty of ventilation is reduced to a minimum.

Amongst other advantages of the electric light, which, although not strictly relating to its sanitary aspect, have nevertheless an indirect effect on health, may be mentioned the following:—Plants grow in rooms lighted by it, and cut flowers exhibit their true colours, and do not quickly wither; paintings show their natural tints and colours to better advantage. Its influence on the health of children is incalculable. An electrically-lighted nursery, even if the light remains on all night long, is free from the noxious vapours produced by candles or gas. The electric light also lends itself to artistic treatment in the most admirable way.

In the adoption of the electric light, therefore, we fulfil the following important considerations:—We do not deprive the air of oxygen, so necessary for our health and comfort; we do not adulterate the air with pernicious compounds of any kind; we avoid the accumulation of vapour; only a small degree of heat is produced; and we facilitate the means of ventilation.

So long as electric lighting is carried on in isolated installations, it will be found difficult, no doubt, to compete with its older rival, although there are cases where the cost of such installations compares favourably with gas. The expense of maintenance by isolated lighting is governed entirely by local considerations. Where the light is required only to a limited extent—say 100 incandescent lamps burning for less than 1,000 hours per annum—the cost will probably exceed that of gas; but where the number of lamps reaches 200 and the number of working hours amounts to about 2,000 per year, then electricity will undoubtedly beat gas. It is, however, unfair to compare the expense of lighting by isolated installations with that of lighting by means of a well-established and elaborate system, whose existence is founded on the experience of half a century. However, in considering the question of expense, the superior advantages which we have endeavoured to point out, inherent in the electric system, should entitle it to a higher price than all other systems of artificial illumination.

The time will come, however, when the electric current will be supplied on a large and comprehensive scale, and when its merits will be fully appreciated by all; then the question of cost will no longer form an insuperable barrier to its universal adoption.

A discussion followed, and

Sir ROBERT RAWLINSON, in summing up, spoke as to the purity, brilliancy, and wholesomeness of the atmosphere wherever the electric light was used. He thought that its advantages over all other illuminants would sooner or later recommend its universal adoption, but there were still difficulties to be got over in order to make it a perfectly safe and certain means of illumination. He referred to the fact of its having gone out at the Health Exhibition, where it was worked under the most favourable conditions, and also alluded to the unfortunate accident which occurred the other day, resulting in the death of one of the attendants on a dynamo used for arc lighting.

Mr. FAHIE, in reply, said that no doubt there were still some difficulties which impeded the successful and economical application of electric lighting, but it should be remembered that difficulties had always to be overcome in the introduction of every new industry, and those attending electric lighting were being removed from time to time, as electricians gained experience by actual practical work. As to the accident at the Health Exhibition, it simply arose from the attendant incautiously placing both his hands at one time on the opposite brushes of the dynamo, thus receiving through his body the current which was being generated to feed some 30 arc lamps. It appears that the unhappy man had been cautioned against placing both hands on the machine, and the accident was wholly due to negligence.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—MONTREAL, 1884.

(*Continued from page* 286.)

ON A NEW FORM OF INDUCTION INCLINOMETER.

[A brief abstract of this paper, read by Mr. C. Carpmael at the British Association meeting on September 1st, was given in the REVIEW of September 20th. We are now able to publish the paper in full.]

Two papers by the Rev. Humphrey Lloyd on Induction Inclinometers were published in 1842, The first, "On a New Magnetic Instrument for the Measurement of the Inclination and its Changes," appeared in the Proceedings of the Royal Irish Academy. In it attention is called to the defects of the vertical force magnetometer as an instrument for determining changes of long period, and an instrument is described for determining

changes in the magnetic inclination by observing the variations in the amount of deflection from the magnetic meridian of a horizontal magnet produced by a soft iron bar, fixed in a vertical position, with the right line connecting the centre of the horizontal magnet and the acting pole of the bar, horizontal and at right angles to the magnetic meridian. In the instrument described in the second paper, the right line connecting the centre of the horizontal magnet and the acting pole was at right angles to the magnet instead of at right angles to the meridian. Subsequently instruments were constructed similar to that described in the second paper, but with two soft iron bars, one on each side of the magnet, the north pole of one and the south pole of the other being presented. One of these has been for 39 years in use at the Toronto Observatory, and gives very good results, but it is not well adapted for photographic registration, as when the inclination is constant the suspended magnet follows the changes of declination, and consequently each reading has to be corrected for such changes.

An instrument has just been constructed, under my direction, for the Toronto Observatory, in which the necessity for a correction for declination is removed. In this instrument the two vertical soft iron bars are adjusted so that the right line joining their acting poles is horizontal, and lies nearly in the magnetic meridian; the centre of the horizontal magnet is at the middle point of this line, and the distance between the bars is such that a position of the magnet at right angles to the meridian is one of equilibrium when the inclination has a value not far from its mean value. The equilibrium would in this position, under the action of the magnetic forces alone, be unstable; but the magnet is hung with a bifilar suspension, which is so adjusted that the couple due to the suspension threads vanishes in the position at right angles to the magnetic meridian.

The suspended magnet carries a mirror, by reflection in which a scale is read with a telescope, and the movements of the magnet are photographically recorded in the usual way. The eye-reading scale is placed at such a distance from the mirror that each division corresponds to one millimetre of the trace, and an increase of scale reading corresponds to an increase of magnetic inclination or dip. Two stops are placed, one on each side of the magnet, so as to prevent its turning much beyond the limits of the scale. This is necessary, as if a pole of the magnet is allowed to approach too near to the soft iron bar it will alter its permanent magnetic condition.

The theory of the instrument with this arrangement is as follows:—

Let M be the measure of the magnetism of the magnet; E be the measure of the total force of the earth's magnetism; θ be the angle of dip; I be the scale reading with magnet suspended; I_0 be the scale reading when an unmagnetised bar of the same weight as the magnet was suspended, *i.e.*, the reading which corresponds to no torsion of the suspension, and which is nearly at right angles to the magnetic meridian.

Let a be the angular value of one division of the scale. Then if we neglect the squares of small quantities, the couple in the horizontal plane due to magnetism induced in the bars by the earth's magnetism is proportional to $M E \sin\theta$. Let us call this couple $\cot\beta$. $M E \sin\theta$.

The couple in the horizontal plane due to the direct action of the earth's magnetism is $- M E \cos\theta$.

The couple due to the suspension threads is proportional to $(I_0 - I)\, a$. Also except when $I = I_0$ the suspended magnet will induce magnetism in the bars. The couple due to this cause is also nearly proportional to $I - I_0$, and may therefore be included with that due to the suspension threads. Let us call the two together $- (I - I_0)\, G\, a$.

There may be an additional couple due to permanent magnetism in the bars. Let us call this couple $M m$.

Then for equilibrium we must have—

$$\text{Cot}\,\beta.\ M E \sin\theta - M E \cos\theta - G\,(I - I_0)\,a + M m = 0 \qquad \text{(i)}$$

If the magnet be turned out of the position of equilibrium through a small angle, $a\,\delta I$, the couple tending to restore it is $G\,a\,\delta I$, so that if T be the time of a complete vibration, and A the moment of inertia of the magnet and suspension apparatus, we shall have—

$$\frac{4\pi^2 A}{T^2} = G.$$

If, therefore, $4\pi^2 A$ has been previously determined in the form $4\pi^2 A = \tau_0^2 .\ M_0 E_0 \cos\theta_0$, we shall have—

$$G = \left(\frac{\tau_0}{\tau}\right)^2 M_0 E_0 \cos\theta_0.$$

The value of $M m$ may be determined in terms of $G a$, by observing the change of scale reading caused by inverting each of the induction bars, after adjusting the poles now presented to the same positions as those previously occupied by the other poles. For in equation (i) the only term which will be altered, will be the last, which will remain the same in magnitude, but have its sign changed. We may therefore write $k\,G\,a$ for $M m$. (In practice k may be made so small that it may be neglected. In the instrument which I have just had constructed I effected this, by giving each of the bars, when in the position in which its permanent magnetism opposed the induced magnetism, a few sharp raps with an ordinary lead pencil so as to set it in vibration, this process being continued until the scale reading was half-way between the reading before reversal of that bar and that after reversal.)

From equation (i) we have, therefore, $\cot\beta$ in terms of $M E$, θ, and I; if, therefore, I, θ, $M E$ are known at any one instant, we can determine β. If k has been made very small, we may consider β as being the value of the dip, when the scale reading of the instrument is I_0, it will then by the original adjustment not differ much from the mean dip at the place of observation.

Equation (i) may now be written—

$$M E \operatorname{cosec}\beta \sin(\theta - \beta) - G\,(I - I_0 - k)\,a = 0 \qquad \text{(ii)}$$

From this equation we see that if δI be the change in I corresponding to a change $\delta\theta$ in the dip

$$\delta\theta = \frac{G\,a}{M.E} \sin\beta \sec(\theta - \beta).\ \delta I.$$

Since the changes in the dip are very small, we may in this equation write unity for $\sec(\theta - \beta)$, we then have—

$$\delta\theta = \frac{G\,a}{M.E} \sin\beta.\ \delta I.$$

If we wish $\delta\theta$ expressed in minutes of arc, we must also express a in minutes of arc. By properly adjusting a we can make the scale coefficient what we please.

The scale reading corresponding to any dip will vary with the temperature owing to variations of the induction coefficients of the bars. If q be the ratio of the increase in the induction coefficient, due to an increase of one degree in temperature, to the whole coefficient, we shall have to apply a correction to the value of β of

$$q \,.\, \frac{\sin 2\beta}{2}$$

and, if $\theta - \beta$ is so small that its product into this correction may be neglected, the correction to be applied to the deduced value of θ expressed in minutes of arc for an increase in temperature of one degree, is

$$- q \,.\, \frac{\sin 2\beta}{2} \operatorname{cosec} 1'.$$

ON DOMESTIC ELECTRIC LIGHTING.

By W. H. PREECE.

I HAVE now to deal with a question which I think will appeal to you more than the technical subject I have so rapidly run through, and that is the question of domestic electric lighting. I am rather surprised to find that in Canada, as far as I have observed, there is no single example of a private house being lighted by the aid of electricity. One instance, by-the-bye, Professor Bovey tells me of, though he did not mention where it is. Our experience of electric lighting in England is rather limited. The first person, I believe, to take the bull by the horns and settle the question of applying electricity to house lighting was that gentleman whose name has cropped up every time we have had occasion to speak, I mean Sir William Thomson. He fitted up his house with the light, and his example has inspired several others. Amongst others I have taken the matter in hand, and I could not do better than describe on this occasion exactly what I have done in this direction. As I remarked, we are backward, generally, as to this subject in England. We cannot get electricity supplied at our doors. We look forward to the day when we shall be able to have it delivered, in some form or other, like you have your ice delivered at your doors every morning out upon your doorstep, though not, as some one suggested, in the form of secondary batteries. I do believe that the day is not far distant when electricity will be supplied at our doors just like water and gas are at present.

I wanted to find out the expense, the difficulty and the trouble involved. To do this I obtained estimates, and calculations of the cost; but these, though honest, are very often not reliable, and you all know that figures may be twisted anyhow.

I am lighting up my house by gas, but I am burning that gas in my garden, and extracting from it that which I want, namely, light, and am discharging into the air of my garden that which I do not want, namely, poison. I want to explain this. It sounds magical, but it is a simple fact. In my garden I have built a pretty little engine-house, in size only 18 feet by 10, and in that house I have fixed a two horse gas engine. In this gas engine my gas is burned, and instead of being burned in the form of light it is burned in the form of power. That gas engine rotates a dynamo, and that dynamo machine produces a current of electricity. It is a small Gramme dynamo machine weighing two hundredweight, and it gives me ample current for my purpose; in fact the current I get is 36 ampères with 42 volts. And I get from my two-horse gas engine 1,512 Watts, that is just a little more than two-horse; so that the efficiency of my gas engine and my dynamo is good indeed. Now this current which is produced is thrown into secondary batteries. I have gone back to the original form of secondary battery invented by Planté twenty-five years ago, which consists of lead plates (two, square) fitted opposite each other in a solution of sulphuric acid. I have seventeen cells. On my gardener going on duty in the morning he starts the gas engine; that engine works from about 9 till 1, and it puts into those secondary batteries sufficient electricity to supply me the whole of the next evening and the next night. Electricity is directed into the house by means of thick copper mains coated with India-rubber. Lamps are fixed in every room, just where they are wanted.

My house is not fitted up with the idea of making a show, but so that I can get exactly what light I want, and

get it in the place *where* I want it. The lamp fittings are extremely ingenious; the most beautiful, indeed, of the machinery. The fixtures are on the movable principle, after the design which Sir William Thomson has introduced; but there are also little movable lamps which enable me to go to my wine cellar, or to search under any bed, or in any dark corner of the house, and go round the garden with a portable lamp. When carrying it I pay out a wire that carries the electricity, which is just like a fishing line. You know how easily that can be paid out and wound in. I have done more than that, I have indulged in the luxury of supplying my little girl with a very large doll's house of four rooms, each room nicely furnished and populated with well-dressed dolls, and each of these rooms has a little electric light of its own.

I have brought with me one of these tiny electric lamps, and will endeavour to show you one of them alight. [Mr. Preece then, amidst considerable applause, with the aid of batteries supplied to the platform, connecting with them a wire in his hand, which was attached to his scarf pin, at a given moment produced a blaze of electricity on his scarf, and as quickly disconnected and reconnected it.] I show you in the interest of science, and for the welfare of those who think of applying electric lighting to their houses.

This same idea of using the electric light for general purposes is carried out to a large extent in our theatres and different places, and last year when I visited Vienna I had my scarf thus fitted up with one of the tiny lamps; and it attracted a good deal of attention. I have astonished many people with it at different times; sometimes I have worn it as a button-hole, and have frequently attached it to the heads of my lady friends as a coronet.

Now all these things show how easily and readily electricity can be applied to various everyday-life purposes. In my house I use lamps that require only 30 volts to keep them going, with safety from shock and fire. I often put the wires into the mouths of my little children in order to illustrate practically to my guests that there is no danger. They do not much like it, but it does not hurt them.

At the door of each room is a little switch that you can turn and produce a light in the room before you enter, thus requiring no match or other assistance. When you go out of the room you turn the handle again to extinguish the light; thus you only make the lamp consume electricity when you really want it. This is naturally a great economy.

Many people say that this light costs twice or three times as much as gas. But they must remember that you only use it one third or one half of the time that you use gas, by economising in the way I have mentioned. Therefore, perhaps, gas comes to about the same thing.

I have instruments about my house that enable me to tell the condition of the batteries, the amount of my current and exactly what is going on; in fact up to the present moment I have really had no difficulty whatever. It has been, of course, a hobby for some months. I have left the house in charge of my sister, who was rather timid for the moment in regard to using the electric light, and I set the question at rest by taking away all the gas fittings and leaving her nothing else, and now in my absence here in Canada I have recently received a letter saying she has had no trouble about it yet.

As regards the expense, I have not studied economy, my desire first being to secure efficiency, and I have done all I could to illuminate the house thoroughly. *My* expense, therefore, is no criterion. I estimate that a house like mine can be fitted in all its details for about £7 10s. per lamp. I do not think I shall spend more than I have been spending for gas. I know I shall not consume so much of the gas, but I pay the gardener a little extra wages for his trouble, and I spend money in cotton waste and oil, but the result will be that the extra outlay will represent a mere fleabite compared with the luxury I get, which amply compensates one for expense and trouble incurred.

I have come to one or two conclusions on this matter. The first is, that until we can get electricity supplied to our doors, we must look upon electric lighting as a luxury, and should be prepared to pay for it as such. But as a luxury, it is nothing compared with the cost of a carriage, or with one's wine bill. The next thing notable is the steadiness and charm and comfort of the light; the durability of decorations, which are not injured by the electric light; the absence of heat and of destructive gases; the non-vitiation of the air, and the longer life one gets. I shall live three or four years longer with the electric light than I should with gas, and all these things make up a splendid result for any amount of money you may spend.

There are difficulties, of course, which will bother any untechnical person, but when we have investigated and once overcome these matters others will be able to follow in our steps and obtain some of the advantages and benefits that we do. You only require to use the electric light when you want it, and you thoroughly appreciate it. I am myself wakeful at night, and especially if I have indigestion. Supposing I want a light to obtain a book or a paper I simply touch a button and my room is at once bathed in a delicious light; having obtained what I want, I touch the button again and out goes that light. Once more, there is no danger from fire. All the trouble and difficulties exist in the matter of distribution. When we succeed in getting central stations for the distribution of the electric light, difficulties will cease and troubles will be infinitely less than we experience in the case of gas.

In London the progress of the electric light has been checked by the most unfortunate Act of legislation which the Government has committed for some time. In 1882 our English Parliament passed an Act restricting the operations of the light, and practically checking its progress. In fact it has put a damper on this enterprise which I do not suppose we shall get over for years. At the same time there are notable experiments being tried. At Colchester, in Essex, they are establishing a central station, and they are going to do the same thing on a small scale in London. There are also one or two other cities which contemplate the plan. I think, in fact, that London would have been lighted by this time with electricity but for the unfortunate Act to which I have referred.

Discussion.

Sir WILLIAM THOMSON said: I have listened with great interest to Mr. Preece's remarks about electric lighting, and I endorse fully what he said as to the pleasantness and the healthiness of it in the house. To those who would carry out the system of lighting private houses, large country houses, and the like, at great distances from towns, where central lighting cannot be obtained, are particularly available. The question of expense takes a different position from that in the town, if the house is in the neighbourhood of water-power. Electric lighting will then be an economy. Sir William Armstrong produces the light at his house at Craigside from a waterfall about one and a-half miles distant. Nothing can be more satisfactory than the result. I wish to point out the vast natural advantages which American cities enjoy in regard to water power at their disposal. Here in Montreal you have the Lachine Rapids within five miles. The problem of making use of that power is easy enough from an engineering point of view. The electric light might easily be transmitted hither by means of a copper wire. It is only where the power at the working end is costly, as with steam power or expense of fuel, that the difficulty is very serious from an economical point of view. With such abundance of water as you have, half the power might be wasted, and yet a good economy realised on the whole. It is unfortunate that legislation in England has not encouraged, but has rather been an obstacle against house-to-house lighting hitherto. Sir F. Bramwell has during the meetings expressed himself warmly, but not more warmly than the occasion demands on this point. England, however, will not, I think, be kept long back by obstructive legislation. I hope that legislation will soon be modified to meet the prevailing wants, and that the true economy of the light will be found out in practice. In Mr. Preece's first paper it was shown that 30 times as much expenditure of energy took place in a gas flame as in an incandescent lamp with the same amount of light. With such a vast difference I cannot doubt that the electric light has a great future before it, and that incandescent lighting will become general, wherever a sufficient number of houses can be grouped together. Say we have a place that wants a machine of some 5,000 or 6,000 light-power. From a central station in that case you use the light economically, for then at double the cost of gas it would be a positive economy if the ordinary gas lamp is kept burning the whole of the night, seeing that gas cannot be put out and lighted again as the electric light may be in anything like reasonable time. The proportionate cost of electricity to gas is, I think, about two to one; and in view of this a central system, enabling a person to pay according to the time the light is used, would be an economy compared with gas. You may add the great advantage secured with respect to your decorations, your ventilation, and your health. The balance, then, will be rather in favour of electricity. I hope the discussion may end in promoting a great national object in the application of science for the benefit of all mankind. (Applause.)

Dr. FRIENDERVELT described a photographic gallery in London, where gas was used for the development of the electric light, a dynamo being worked by a gas engine placed in the cellar. The negatives were printed off by the aid of the electric light. The convenience of this he need not dwell upon.

Prof. FORBES said: I think we all have to thank Mr. Preece heartily for his address. His subject is one of much interest for this meeting at Montreal, because I must say that I have felt astonished that during the whole time we have been in Canada we have not seen a single incandescent lamp, except that just now noticed in Mr. Preece's scarf. (Laughter.) Really the whole subject of domestic lighting seems to have been neglected in Montreal and in Canada generally. The interest of this city ought to be awakened to the remarkably favourable conditions under which it is placed, owing to the fact of having such an unlimited water power at its disposal at nominal expense. I would draw attention to the fact stated by Sir William Thomson, which may have struck some people here, that it is a serious matter to take up electric lighting if its cost may amount to something like double the price of gas. I can understand many people saying that it is an enormous outlay to pay in Ottawa and Quebec treble the cost of our gas in Montreal, that is, 3 dollars 40 cents. But two things should enter into your calculations. One is the enormous price of gas here, and the other the infinitesimal price of water power. We find in England that with gas at 3s. per 1,000 feet, the electric light can almost compete with gas on a large scale. If we used water power we could considerably surpass the gas in economy. If, then, we can do that, and when we come out here and find gas at 3 dollars per 1,000 feet, it is perfectly clear that with such ample water power it is only a question of the time within which the electric light will be introduced into every one of your cities. (Hear, hear.)

Mr. CARPENTER described some experiments made by a friend of his at Hawick, in the south of Scotland, who had an advantage

which Mr. Preece had not. He had built a new house and fitted it up 5 miles out of the town of Hawick. He went into the question of the relative cost of gas and electricity for lighting purposes. Through the grounds of his house there runs a small stream falling into the Teviot. He dammed this little stream, which never runs dry, and then he got a fall of 25 feet. The lake, moreover, which he thus made improved the appearance of his grounds. At the foot of the fall thus obtained he erected an American turbine with a dynamo machine attached. He led the wires in and fixed 90 lamps. The cost of all this was very considerably less than that of bringing out gas from the town. The total cost amounted, not as in Mr. Preece's case, to £7 per lamp, but to very little over £4; the total estimate being a little over £360 for the 90 lamps. This installation was started last Easter. I had a note from him a few days ago, in which he said that he had never had the smallest difficulty. My friend decided to be master in his own house, and he had an arrangement by his bedside so that when he retired he could not only cut the lighting off, but he could save his water-power, for it was simply necessary for him to send a current from his bedside to the sluice half-a-mile off, and that allowed the water to accumulate till the next day. A somewhat similar arrangement was laid down by Mr. Hammond in Highgate. He lives at the top of the hill, and is not so fortunate as to have water-power at his command. He has laid down a gas engine in one of his houses. Gas is tolerably cheap there, and his experience was this, that if he spent 300 cubic feet of gas on his engine, and measured the amount of light produced, he would have had to burn 400 cubic feet of gas at the burner for the same lighting effect. This illustrates a comparison between gas and electric lighting. When gas lighting first came in people insisted on having a much greater quantity of light than they had had from the old oil lamps, and they paid more for it. Precisely the same thing has happened in England as to electric lighting. One reason of its heavier cost is that people insist on having more light. At the conference of the Society of Engineers a good deal was said on this aspect of the matter. I may add that neither in Boston nor New York could I hear of any incandescent lighting.

Sir F. BRAMWELL testified that Mr. Preece had by the aid of the gas engine and secondary batteries lit up his house to absolute perfection. His house was old-fashioned, with a charming dining-room, but too low according to our modern ideas. That room was lit with four lights when some dozen of guests were gathered round one evening, and the appearance of the table was all that could be desired. There was not the slightest fluctuation in the light, and the temperature was not more than that outside. There was no necessity in Mr. Preece's system of any permanent light outside. When they left the house a light flashed out and bade them farewell. Nothing could be imagined more complete or charming. As to the gas question, he had experimented one whole day at the Royal Institution, with the result that the amount of gas for the motive power of a gas engine would not give an equal amount of light as an illuminant. But the point was not can electric lighting be as cheap as gas? but can it be made as cheap to persons who value their furniture and health, and who now can pay for wax candles and good lamps? If it could be made cheap to that class there were a large number in London who would be glad to use it. There was no doubt that the development of electric lighting had been checked by the legislation which had been referred to. He hoped that some day people would come to their senses. The present Act said that at the end of 21 years they should have to part with the rights they had. They got nothing based on prospects, but simply the value of the materials then existing. He could not believe that that injustice would be allowed to continue. It might be that the delay in electric light development would be advantageous, because improvements might be made in the interim. If electric lighting only had had fair play it would ere this have been largely used in the best parts of London as a luxury.

The vote of thanks was then heartily accorded.

Mr. PREECE, in responding, said:—In answer to the question how do I store electricity for my pin? I may say that I do not store it at all. No more ridiculous term than that could be employed. I use a secondary battery. The only instance I know of where electricity is stored is the case of a Leyden jar or condenser. What is stored, if you use the term, is energy; that is, we put something into the battery and take it out again; but it is not electricity. As to my arrangements, I mean in future to use my engine on Monday only, for the purpose of doing what is described by the misnomer of "storing" electricity. It will charge the batteries, which I shall have big enough to give me sufficient power for the rest of the week.

The discussion then terminated.

ON THE DISCHARGE OF ELECTRICAL ACCUMULATORS.

By E. FRANKLAND, F.R.S.

IN a communication to the Royal Society on this subject (*Proc. Roy. Soc.*, Vol. XXXV., p. 67) I described certain experiments which went to prove that the active material in an uncharged accumulator (in which, when charged, spongy lead and lead peroxide are the opposing plates) is lead sulphate; that, in charging, this lead sulphate is decomposed on the positive electrode, the formation in both cases of hexabastic sulphuric acid, and that in the discharge these chemical changes are reversed, lead sulphate being reproduced on both electrodes and plates. I also stated that the sulphuric acid thus added to or withdrawn from the liquid contents of the cell can be made to indicate by change in specific gravity the degree of charge in the cell at any given moment. At the conclusion of the paper I expressed a hope that further experiments would enable me to denote in terms of current from the cell the definite relation between the amount of energy stored and the weight of sulphuric acid liberated. I have not as yet, however, obtained results which would justify me in announcing this equivalent, but I venture to think that the details of some experiments which I have made with this object may not be altogether uninteresting at a moment when the storage of energy is attracting so much attention.

The storage cell employed contained 10 plates, each having two active surfaces of 11 inches by 9 inches. Rejecting the free sides of the two endmost plates, the total effective surface was 12·3 square feet. These plates were completely immersed in dilute sulphuric acid, of which the cell contained about 14 imperial pints. The cell was fully charged in series with several others by a current from a Siemens shunt machine, varying usually from 15 to 20 ampères, and it was then allowed to rest for three days. The discharge was made through a piece of platinum wire, 1·035 mm. in diameter and about 10 inches long. Carefully sheltered from drafts, this wire was maintained at a red heat just visible in the dark so long as the current did not sink below 17 ampères. The current was measured by a Siemens electro-dynamometer constantly included in the circuit. As the complete discharge occupied 73 hours, it had to be frequently interrupted. These interruptions are not mentioned in the following tabulated results, but they are noted in the accompanying diagram, which shows these results in the form of a curve. The current maintained itself at between 19·61 and 18·09 ampères for nearly 22 hours, and then fell very suddenly in the course of about an hour to less than three ampères, at which rate it continued for upwards of 50 hours. At the end of this time the current was still 2·57 ampères, when it was stopped at 10·30 p.m. At 6·30 the following morning, on re-establishing the circuit, no perceptible current passed.

The following are the tabulated results of the discharge:—

Date. April.	Duration of discharge. H. M.	Currents in ampères.	Ampère hours.
7	1 0	19·61	19·61
8	2 30	19·24	48·11
8	5 6	18·81	95·98
10	3 0	18·61	55·88
10	0 45	18·37	18·78
10	4 38	18·28	84·39
10	4 15	18·23	77·48
10	0 30	18·09	9·05
10	0 8	17·77	2·37
10	0 18	15·37	4·61
10	0 12	9·45	1·89
10	0 9	5·42	·75
10	0 23	3·67	1·41
15	1 14	2·87	3·54
15	6 50	2·78	18·65
15	2 55	2·41	7·03
16	2 15	2·78	6·14
16	0 45	2·65	1·99
16	1 55	2·57	4·98
17	5 10	2·57	13·28
17	2 20	2·49	5·81
17	1 5	2·41	2·61
18	15 50	2·57	40·69
19	1 15	2·78	3·41
19	3 15	2·57	8·35
20	2 22	2·78	6·46
20	3 0	2·57	7·71
	73 5		545·81

The cell therefore kept up a current for 73 hours 5 minutes, and delivered an aggregate charge of 545·81 ampère hours. Of this charge 404·18 ampère hours were delivered with an electromotive force of about two volts, whilst 141·63 ampère hours were delivered with an E.M.F. of only about three volts. This result may be tabulated as follows:—

	Ampère hours.
Useful electricity or electricity of high E.M.F. (two volts or upwards)	404·18
Useless electricity of low E.M.F.	141·63
Total	545·81

In the experiment just described the discharge at high electromotive forces was rapid, but the cell had many intervals of rest, several of them long ones. Thus, after the first hour's discharge at the rate of 19·61 ampères, there was a rest of 21½ hours. Then the discharge was continued at the rate of about 19 amperes for 7 hours 36 minutes, followed by a rest of two days, when the discharge was maintained at nearly the same rate through the same resistance for 8 hours 23 minutes. Then came another rest of four days, at the end of which time the discharge started at

exactly the same rate as that at which it had previously left off, and continued at very nearly the same rate for 4 hours 45 minutes longer, when it suddenly fell off to about 2¾ amperes.

In the next experiment, which was made with a cell similar in all respects, the heavy current was taken continuously up and down the fall, with the exception of one break of 14 hours at the end of six hours. The following are the numbers noted during the discharge:—

Date. June.	Duration of discharge.	Currents in ampères.	Ampère hours.
	H. M.		
9	6 5	17·47	106·23
10	1 40	17·47	29·11
10	1 60	17·15	31·44
10	1 40	16·50	27·50
10	1 15	4·06	5·07
10	0 35	3·62	2·05
10	1 30	3·15	4·72
10	2 5	3·28	6·83
11	0 5	11·69	·97
11	0 12	11·33	2·27
11	0 6	9·54	·95
11	5 0	2·37	14·35
11	6 20	1·82	11·53
12	0 5	9·10	·76
12	0 5	6·42	·54
12	0 5	4·06	·34
12	0 5	2·57	·21
12	1 40	2·03	3·38
12, 13	36 20	1·82	66·13
14	10 40	1·32	19·41
Here current of 22·15 was passed through cell for 1 hour, and intervals of 3 hours allowed before continuing discharge.			
14	0 3	9·96	·50
14	0 7	8·03	·95
14	0 10	4·06	·68
14	0 30	3·70	1·35
14	0 10	2·87	·48
14	0 10	2·57	·43
14	1 20	2·41	3·21
14	0 25	2·03	·35
14	6 35	1·82	11·98
15	24 0	1·82	43·68
16	20 0	1·82	36·40
16	2 0	1·58	3·16
17	0 1	2·87	·05
17	0 1	2·08	·03
17	0 3	1·82	·09
17	0 50	1·58	1·32
17	12 20	1·29	15·91
18	0 1	2·41	·04
18	0 15	1·58	·39
18	0 45	1·29	·97
18	0 30	·91	·45
	147·39		457·26

The current maintained a nearly uniform rate of between 16½ and 17½ amperes for 11¼ hours, or only for about one-half the time in the previous experiment. It then suddenly sank to little more than 3 amperes, but rose again for a few minutes to over 11 amperes after a rest of 12 hours. It then sank to 3 amperes, and finally to less than 2, after nearly 12 hours continuous discharge; but after 14 hours' rest it again rose for a few minutes to nearly 10 amperes, to sink in 15 minutes to 2·57, and in another hour and 40 minutes to 1·82 ampere, at which rate it remained for 47 hours continuously.

Under perfectly constant conditions of discharge it was interesting to try the effect of interpolating a fresh charge from the dynamo. Accordingly the discharge was interrupted, and immediately a steady current of 22·16 amperes was sent through the cell for exactly one hour, and the cell was then allowed to rest for three hours. On recommencing the discharge through the same resistance as before, a current of 9·96 amperes was obtained; but this was maintained for three minutes only, and at the end of an hour it had sunk to 2·87 amperes. It was only, however, after the lapse of eight hours that the rate of 1·82 ampere was resumed, and this was afterwards continuously maintained for 52 hours. Thus, of the 22 ampere hours with an E.M.F. of about 25 volts put into the cell, only 8·94 ampere hours came out again with a higher E.M.F. than that possessed by the previously constant current of 1·82 ampere. Moreover, the E.M.F. of the augmented current never exceeded 1·09 volt, whilst in 20 minutes it sank to ·49 volt. This result shows how wasteful it is to keep a storage cell in circuit after the high E.M.F. portion of its charge has been extracted. Altogether the complete discharge of this cell occupied 147 hours 39 minutes, and there was obtained:—

	Ampère hrs.
Useful electricity or electricity of high E.M.F. (two volts or upwards)	194·38
Useless electricity or electricity of low E.M.F. omitting the 22·15 amperes hrs. interpolated...	240·78
Total	435·11

The cell, therefore, contained a smaller aggregate charge than the previous one, but what is of much more importance the proportion of useful electricity was greatly diminished, for whilst, in the first experiment, the proportion of useful or useless electricity was 5 : 7 : : 2, in the second it was only 1 : 6 : : 2. It can scarcely be doubted that this diminished proportion was due to the much more continuous nature of the discharge in the second case.

In order to test this conclusion, however, a third cell was submitted to experiment. This cell contained 13 pints of diluted acid, but only eight plates 8·5 inches × 11 inches, or an aggregate effective surface of only 9·09 square feet, as compared with 12·3 square feet in each of the former cells. On this account the cell was discharged through a somewhat higher resistance, so as to obtain a lower rate of discharge.

Duration of discharge.	Current in ampères.	Ampère hours.
H. M.		
9 45	16·2	157·9
6 35	15·8	104·0
2 45	15·5	42·2
1 0	14·8	14·8
2 20	14·7	34·3
15	13·2	3·3
20	12·8	4·3
15	10·9	2·7
25	10·4	4·3
25	9·9	4·1
15	6·6	1·65
25	4·6	1·91
20	3·75	1·25
25	3·28	1·36
1 0	2·57	2·57
50	1·82	1·52
2 30	1·29	3·22
111 30	91	101·46
141 20		486·84

The cell maintained a nearly uniform current, averaging 15·8 amperes for almost the same time (22 hours) as the first cell. The current then sank, not quite so suddenly, to 91 amperes, at which rate it continued steadily for 111¼ hours. During the course of this discharge the cell had the following period of rest:—Discharge, 6 h. 5 m.; *rest*, 25 h. 35 m.; discharge, 5 h.; *rest*, 8 h. 30 m.; discharge, 4 h. 20 m.; *rest*, 6 h. 10 m.; discharge, 4 h. 40 m.; *rest*, 8 h. 15 m.; discharge, 121 h. 15 m.

These periods of repose had a most beneficial effect on the economic value of the charge. For whilst the cell, discharged with but little rest, gave a proportion of useful to useless electricity of only 1 : 6 : : 2; this cell, with intermittent discharge, yielded a result expressed by the proportion 6 : 5 : : 1, which is even higher than that obtained from the cell used in the first experiment. The complete discharge of this cell occupied (exclusive of the periods of rest) 141 hours 20 minutes, and there were obtained:—Useful electricity, 371·9 amperes; useless electricity, 114·9 amperes—total, 486·8 amperes.

In all these experiments moderate currents only were drawn from the cells, such as would be used for the supply for 14 or 15 Swan lamps of 20 candle-power; but much heavier currents can be obtained if desired, for Messrs. R. E. Crompton inform me that they have obtained from a cell of 12 plates of the same construction a steady current of 250 amperes. It would thus be possible, by coupling in parallel only 30 such cells, to obtain for a short time a steady current of no less than 7,500 amperes. The results of these experiments permit the following conclusions to be drawn:—

1. The energy of a charged storage cell is delivered in two separate portions, one having an E.M.F. of 2 volts and upwards, the other an E.M.F. of 5 volts or under; one of these may be termed useful electricity, the other useless electricity.

2. The proportion of useful electricity obtainable is greatest when the cell is discharged intermittently, and least when the discharge is continuous.

3. Neither in the intermittent nor continuous discharge at high E.M.F. is the current, through uniform resistance, augmented by rest. At low E.M.F., however, the current, after continuous discharge of the high E.M.F., is greatly augmented, but only for a few minutes. This augmentation of current at low E.M.F. after rest is barely perceptible when the high E.M.F. discharge has been taken intermittenly.

4. The suddenness of fall in potential indicates two entirely distinct chemical changes, the one resulting in an E.M.F. of about 2·5 volts, the other in one of 8 volts.

5. The chemical change producing low E.M.F. is the first to occur in charging, and the last to take place in discharging a cell. It is the change which occurs during what is called the formation of a cell, and in the interest of economy, a reversal of this change should never be allowed to take place.

6. It would be difficult to suggest an explanation of the nature of these two chemical changes; but I refrain, pending their actual investigation in which I am now engaged.

7. Currents of enormous strength may be obtained from storage batteries coupled up in parallel. For instance, a current of

25,000 amperes is quite feasible from only 100 cells. Such a current reduces to insignificance the output of the largest dynamo ever built. It is to be hoped that currents of this magnitude will open up new possibilities of research into the constitution of matter.

PORTRUSH ELECTRIC RAILWAY.

(*Continued from page* 248.)

DISCUSSION.

Sir FREDERICK BRAMWELL: There is no doubt but what this railway is an electrical and mechanical success. The arrangements for passing gateways are thoroughly satisfactory. That plan by which the trams cross each other on inclines is a very happy idea. I am sorry to hear that the turbine is still a difficulty. I suggested, and I do not see but what it is applicable, that some such governor as Durham's, used for marine purposes, should be tried. Sir William Siemens pointed out at the opening of the railway, that you can in the case of an electric tramway afford to lose between motive power and that on the car. Under the circumstances a considerable loss could be sustained without more horse-power being used. In the present case, however, the horse-power is obtained from the waterfall gratuitously. I was glad to become a shareholder in this undertaking, thus showing my confidence in it. I believe Dr. Traill's mode of connection between the moving car and the current, of this concealed detector, is one which ought to be and is successful so far as tried, and if it continues successful it will obviate the erection of posts and rails which clearly would not be admissible in towns and other places.

Mr. FRANCIS spoke of the power which in the waterfalls in America was running to waste and which might be utilised for electrical tramways. He instanced particularly Niagara, where some three millions of horse-power was running to waste. At the rate of 20 horse-power to the mile, that would drive 1,500 miles of railway, and furnish all the locomotion wanted. They were now running locomotives of 100 tons each, including the tender, and if they could dispense with them it would be an immense saving to the country.

THE COUNTY SURVEYOR OF ANTRIM added his testimony to the statements made in the paper as to the success which attended the exertions of Dr. Traill. He (Dr. Traill) has, he continued, clearly shown you that it was a technical process from beginning to end. It is applicable to a raised railway, because you can get over the difficulties which access to fields create. In the towns you will require underground work, as indicated by Mr. Holroyd Smith's paper. Apart from the question of this power as a motor for railway or tramway purposes, it is clear that in a country like this, where you go on so much upon your own account, the idea comes in with great force.

Dr. TRAILL, in reply to enquiries, said they were limited to a speed of 10 or about 12 miles an hour, but they once ran 18 miles with the greatest ease.

The CHAIRMAN: We used in some of our dynamo-electric machines a form which may answer Dr. Traill's purpose, possibly, *i.e.*, a Howson governor. The admirable feature of this particular railway is its peculiar regulating capacity. One of these days, when the doctor comes to develop Niagara in that way, we shall expect that self regulation to be adopted, for it is important in this country. And when scientific men come here and put their money into it, we are sure the thing will go right.

In closing the discussion, Sir FREDERICK BRAMWELL announced the exhibition to be held next year in London, in the building now occupied by the Healtheries, to embrace machines, processes and products invented or introduced since 1862.

ON CLARK'S STANDARD CELLS.

(*Continued from page* 227.)

DISCUSSION.

In reply to Prof. Fitzgerald,

Lord RAYLEIGH said: One argument which led me to adopt this form of cell was its facility for changes.

Sir WILLIAM THOMSON; What is the form you recommend as giving the best standard of electromotive force?

Lord RAYLEIGH: The cell was designed for use with mercury. I do not profess to have got final results. My cells are still under test, and they behave remarkably well. The greatest difference I find between the cells is under $\frac{1}{1000}$th part. I do not know what these differences depend upon yet; and it is hard, therefore, to say within what limits one is safe in making up Clark's cell. The safest plan would be to make a good many and see if they agree. If anybody wishes to standardise his cells I would recommend his doing it through the silver voltameter.

The American Institute of Electrical Engineers.—The interest in this association, whose formation we chronicled some months ago, seems to be of a very evanescent kind, for already, notwithstanding that very interesting papers have been read, Mr. Keith, the secretary, has found great difficulty in securing anything like respectable attendances at recent sessions.

THE BORING OF MARINE ANIMALS IN TIMBER, &c.

AT the International Forestry Exhibition, Edinburgh, recently, Prof. M'Intosh delivered a lecture on "The Boring of Marine Animals in Timber, &c." The lecture, we think, possesses points of interest to our readers.

Prof. M'Intosh began by stating that the burrowing of marine forms was a feature familiar to every zoologist, for scarcely a dead shell could be dredged from the sea-bed that was not perforated by boring sponges. In the same way the surface of the limestone rocks of our southern shores was riddled by those sponges. So far as at present known, sponges bored only in calcareous substances, and there was a difference of opinion as to whether the agent in boring was the spicules or the soft animal jelly of the sponge. As regarded the boring of the purple sea urchins in gneiss and granite, the teeth were the main agency in the perforations. The group of annelids included many boring and burrowing forms, some perforating sand and others earth; while many bored in aluminous shale, sandstone, limestone, shells, and various substances. Each form, moreover, made a characteristic tunnel in the rock, so that the borer could in most cases be determined. None, however, bored wood, and though pieces of telegraph cable had been several times sent him, with accompanying annelids as the depredators, in no instance had the lecturer been able to connect them with the injury. There could be little doubt that those forms performed a useful function in the disintegration of dead shells and in corroding the surface of calcareous and other rocks. The crustaceans and the molluscs were groups that were conspicuous in the perforation of wood and allied materials. Of crabs, the *Cheluria terebrans*, a form less familiar to Scottish zoologists than to their southern colleagues, was in xylophagous powers even more destructive than the common Scotch boring crab—the gribble—its excavations being considerably larger and more oblique. Though the gribble—*Limnoria lignoram*—must have been familiar to observers from a very early period, it was first described by Dr. Leach only in 1811, when Mr. Robert Stevenson, the celebrated engineer, found it burrowing most destructively in the large beams of Memel fir supporting the temporary beacon on the Bell rock. Other logs of pine on the rock were reduced at the rate of about an inch a year, and the house timbers were so much destroyed by the gribble that many stood clear of the rock, supported only by the iron bolts and stanchions. It attacked all kinds of submarine woods; and the late Dr. Coldstream, Leith, had told them that in 1825 so extensive were the ravages of this creature that many of the piles of Trinity Chain Pier had to be replaced after four years' service, and studded all over with broad-headed nails from the base to the limit of high-water mark. Having described the structure of the gribble and its mode of boring, the lecturer said it had also acquired the habit of perforating the protecting envelopes and gutta percha in which submarine telegraph cables were sheathed. The work of the burrowing crabs, however, was quite overshadowed by the far more serious encroachments which the boring shellfishes were capable of making in timber and similar substances, as well as in rocks of various kinds. Prof. M'Intosh pointed out the boring of the pholas and date shells in rocks, and went on to describe the destruction caused by xycophaga, which was to be seen in the deep water off the Firth of Forth and elsewhere in England and Scotland. It was, he said, a little bivalve shellfish or mollusc, intermediate in structure between the stone-boring pholas and the strictly wood-boring teredo. There was very little externally in the wood attacked by this form to attract attention, except the presence on the surface of minute apertures, which indicated the points by which the young animals had entered; but on breaking open the wood the adults were found in smooth tunnels in every fragment large enough to afford a lodgment. The most conspicuous genus of wood-borer, however, was the teredo or shipworm, species of which occurred in every ocean. In the tube of the teredo the annelid (*Nereilepas*) was often found, and some observers maintained that it was the destroyer of the teredo, but the lecturer had some hesitation in subscribing to that theory. The very same species of annelid occurred abundantly along with the common hermit crab in the shells of the great whelk, and the association of annelids with other forms in tubes or elsewhere was extremely common; but it was not for the purpose of preying on their neighbours, though the bodies of their hosts were in many cases softer than those of the teredo; they were what zoologists called messmates—dwelling in association with other animals. The object in life of all the species of teredo was to bore ceaselessly into timber, the tunnels in which varied from one to two feet in length in the case of the common teredo to fully a yard in the great teredo. Prof. M'Intosh then gave a brief outline of the history of the teredo, which appeared to be mentioned for the first time in the "Knights of Aristophanes," and said that the French and Dutch suffered much more seriously from its ravages than we did. The theories that had been brought forward to explain the mode by which marine animals perforated material so different as wood, limestone, wax, granite, and aluminous shale, might be ranged round two great centres—the chemical and the mechanical. The advocates of the chemical theory seemed to take it for granted that the borings occurred chiefly in calcareous substances, and with propriety, therefore, they made their solvent an acid. That notion, however, was unable to explain the perforations in media totally impervious to such action; while no trace of acid was found in

many borers, and while present in some, it was likewise characteristic of other marine animals that did not bore. The mechanical theory, again, supposed that the animals perforated by means of shells or gritty particles in the case of molluscs, of teeth in sea-urchins, bristles in annelids, and horny processes in certain sea-acorns and gephyreans; but they were left in doubt concerning the extensive and wonderful excavations of the sponges, the bryozoa, and the rest of the cirripedes. Alluding to the methods of protecting submarine timber from the ravages of such animals as he had been speaking of, Prof. M'Intosh said different kinds of wood were mentioned as being impenetrable by such boring action, but so far none had been successful. There were many preparations for the treatment of the wood before immersion. Soluble bitumen, silicated lime, and various compositions had each in turn been tried externally; while silicate of lime, creosote, and other fluids had been forced, under great pressure, into the tissue of the woods. The experiments of the Dutch Commissioners, who investigated the matter, had led them to the conclusion that no external protection other than metallic sheathing or the studding of the wood with broad-headed nails would be successful in resisting the attacks of these borers, while the only impregnation they found reliable was creosoting. In conclusion, Prof. M'Intosh pointed out that while the Dutch, French, and other Commissions had done material service in regard to the best means of protecting timber from the attacks of borers, the subject was by no means exhausted. On the contrary, it would form a fitting object for research at the marine laboratories which at last, he was glad to say, were being established on our coasts. That ceaseless boring of wood was not, however, an unmitigated evil. The masses of timber swept seawards by many foreign rivers would prove a serious impediment to navigation if the marine borers did not slowly but surely accomplish their dissolution. In the same way the relics of many a ship in the depths of the sea were disposed of, and even utilised for the increase of animal life, which was, directly or indirectly, connected with the food of fishes, and, consequently, with the welfare of man. The lecture was illustrated by a series of spirit and dry preparations and coloured drawings; and at the close a cordial vote of thanks was, on the motion of Prof. Heubrecht, Utrecht, awarded to Prof. M'Intosh.

TESTS OF INCANDESCENT LAMPS.

Certificate of Last Year's Electric Exhibiton in Vienna.

OBJECT tested:—Gatehouse lamps. Date of examination, October 11th, 1883.

Observers:—*A.* Electric measurements: Prof. Dr. Erasmus Kittler, of Darmstadt; Dr. E. Mais, Prague; Professor Dr. Antonio dos Santos Viegas, Coimbra. *B.* Photometric measurements: Prof. Dr. E. Voit, Munich.

Candle-power in English normal candles.	Strength of current in ampères.	Potential difference in volts.	Resistance, hot, in ohms.	Electrical energy absorbed in volt-ampères.	Volt-ampères per normal candle.	Normal candles per electric horse-power.	REMARKS.
λ	i	e	$r = \frac{e}{i}$	ei	$\frac{ei}{\lambda}$	$\frac{736\,\lambda}{ei}$	
5·99	0·970	46·01	47·46	44·61	7·45	99	Lamp No. 3, normal at 16 candles.
8·40	1·022	48·30	47·28	49·33	5·87	125	
11·12	1·072	50·65	47·24	54·30	4·88	151	
15·29	1·129	53·15	47·08	59·99	3·92	188	
21·93	1·193	55·88	46·84	66·66	3·04	242	
30·76	1·263	58·86	46·59	74·36	2·47	304	
41·52	1·350	62·42	46·24	84·26	2·03	363	
5·50	0·899	39·86	44·35	35·82	6·51	113	Lamp No. 2, normal at 16 candles.
6·97	0·937	41·55	44·37	38·91	5·58	132	
8·86	0·980	43·67	44·55	42·80	4·83	152	
11·02	1·017	45·06	44·33	45·80	4·16	177	
14·76	1·066	47·24	44·32	50·36	3·41	216	Burnt through at 100 normal candles.
19·67	1·121	49·55	44·22	55·53	2·82	261	
24·61	1·179	52·04	44·13	61·37	2·49	295	
33·12	1·251	55·15	46·09	68·97	2·08	353	
13·84	1·047	45·72	43·67	47·88	3·46	213	Lamp No. 1, normal at 16 candles.
18·48	1·098	48·00	43·72	52·70	2·85	258	

REMARKS.

1. The English normal spermaceti candle, with a flame of 45 mm. in height, was taken as the unit of light.

2. In the above determinations the glow of the lower end of the carbon filament was perpendicular to the measuring scale of the photometer.

3. The coefficient of the intensity of light was determined for lamps No. 2 and No. 3, being for the former 0·82, and for the latter 0·74. The strength of light in the normal position of the lamp, multiplied by this coefficient, gives the mean strength of light of the lamp.

(Signed) J. STEPHAN, President of the Technical Scientific Commission.
KITTLER, President of Section III.
E. VOIT, Secretary of Section III.

Vienna, *April 4th*, 1884.

ELECTRICAL TORPEDOES.

THE illustration shows a general view of a system of harbour and coast defence worked out in great detail by Mr. J. S. Williams; and it is said that tests have been made which demonstrate the practicability of the devices employed by him.

According to this plan, generating stations may be fixed at any convenient places where power can be obtained from wind, water or coal, for driving dynamo machines or other apparatus for developing electric currents which may be of any force. The dynamo machine employed by Mr. Williams is constructed on a similar plan to that of his electromotors.

By the use of automatic pressure regulators, variable resistances and cut-outs interposed between the generators and accumulators and between the accumulators and the appliances in the working circuits all parts of the system are enabled to operate without conflict, and the operation of parts of the system may be made independent of the developing or reserve source when necessary or desirable. By means of suitable cables the electrical energy is conveyed along an extended coast line to any number of fixed points and stored there in accumulators ready for discharging into the working circuits when required.

This arrangement is said to secure several important advantages. The producing plant can be used to its full capacity, and the force in the working circuits is rendered independent of that developed by the producers. The main cables or conductors can be kept constantly employed for conveying the energy to the distant points where it is held in reserve, and conductors may be used of lighter section than is otherwise possible. The accumulators are, moreover, provided with means to disconnect them automatically or otherwise from the charging circuit when they are fully charged, and have also appliances for preventing the backward flow of the current towards the source. Torpedoes, torpedo launches and floating batteries are provided with accumulators which can be charged by being connected in the electrical circuit from the reserves or from the main circuit, or by means of branch cables carried out to buoys moored off the shore, the operation of charging can proceed there.

The accumulators in the equipment of the torpedoes are specially designed to discharge rapidly the energy required to propel the vessel, and to have the maximum of active surface and storage capacity with a very small weight.

A pressure regulator working automatically interposed between the accumulator and the motor ensures uniformity in the speed of the motor under conditions of a decreasing store of energy, excepting when the speed governor interposes resistance, or when a variable resistance device in the circuit from the accumulator to the motor is manipulated by the operator at the starting station by means of a variable resistance or circuit closer on the switch board, which is connected with the other one by the electrical cable coiled in the torpedo, and paying itself out as the vessel advances. These latter devices provide means for the speed of the

motor being varied, or the motor stopped and started at will from the distant starting point.

Electrical steering appliances are also employed, which can be supplied with power through the electrical cable from the key board at which circuit closes and reverses, and variable resistances are arranged and adjusted so as to vary the current passed into the cable circuit in accordance with the force required to maintain the rudder at any angle required.

Means are also employed in the cable circuit to regulate automatically, to some predetermined standard, the electric pressure before passing it through the circuit.

Similar controlling and regulating devices are employed when the electrical mechanism combined with the rudder is supplied with power through an electrical circuit from the accumulator, which forms part of the equipment of the torpedo. A variable resistance and circuit reverser are placed in the torpedo in this circuit in order to regulate the pressure automatically, and also to reverse the connections, and to vary the conductivity of the circuit. These devices are arranged so as to have their action varied and controlled by the electric current passed through the variable resistance and circuit reverser upon the key-board under the manipulation of the operator.

For indicating the position of the torpedo and thus enabling the operator to correct, if necessary, its direction by steering, either fixed vertical sight rods may be used, carrying hooded incandescent lamps which can be thrown into circuit at will; or an arrangement of solenoids or other electric devices may be employed for raising and lowering guide rods which throw the lamps into circuit automatically as they rise.

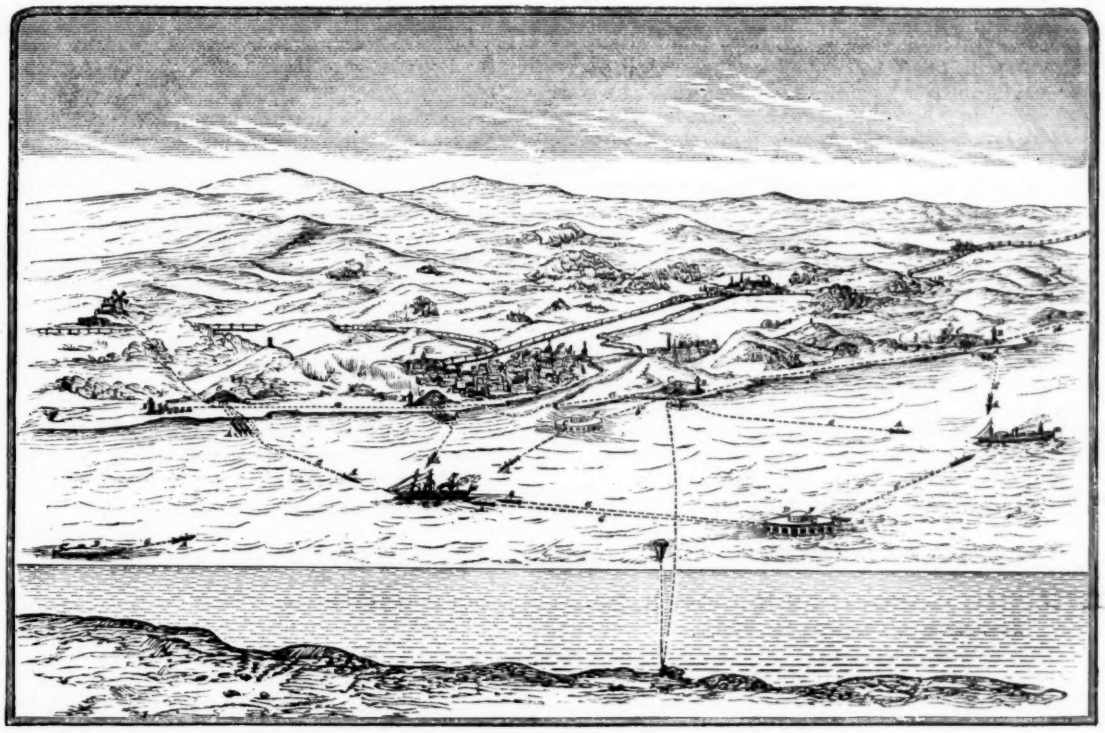
Similar electrical appliances for propulsion and steering are applied to the equipment of torpedo launches and of floating batteries which carry a store of torpedoes and can approach to within a mile or two of hostile vessels and from thence discharge and control with precision the operation of the torpedoes.

The torpedo motor can be worked direct from the operating station either from a dynamo or an accumulator, through the medium of the electrical cable, with the regulating devices interposed as in the other case, and thus a steam launch or a man-of-war having steam power on board can discharge and propel these torpedoes.

It appears to us that there is too much elaboration in the Williams system of torpedo warfare, and we doubt very much whether any Naval administration would feel justified in adopting such a scheme as it now stands.

Combinations of generators, motors, secondary batteries and the great variety of subsidiary apparatus connected therewith have not yet shown us that implicit confidence can be placed in the efficiency of the apparatus at the times when absolute certainty of action is required. It would not be a difficult matter for an enemy's ship to grapple for and break the network of cables by which Mr. Williams proposes to connect any number of fixed points.

Altogether, the scheme appears to us somewhat too visionary for practical employment.



THE JABLOCHKOFF ELECTRIC LIGHT COMPANY, LIMITED.

IN our last issue we asked a question respecting this company, to which we have not, however, yet received any reply. We are aware that it has been proposed to form a company to take over the business and plant, &c., as a going concern, and it is stated that the whole of the property belonging to the company, which on August 31st, 1883, had a subscribed capital of £76,421 can be purchased for the small sum of £8,200, payable £4,000 in cash and £4,200 in deferred shares of the company to be formed. Is this really the best that can be done in the interests of the shareholders and of the creditors?

Surely it would answer the purpose of some established electric light company to buy at the price named! The property to be sold comprises, in addition to the goodwill, sixteen letters patent for Great Britain and the Colonies; leasehold manufacturing premises, fitted complete, at 33, Albert Embankment; carbon candle manufactory, with experimenting and testing rooms, and a large stock of dynamos, wires, &c., &c.; two 25 H.P. Marshall steam engines, dynamos, shafting, &c., &c., at 65, Belvedere Road; and a 25 H.P. steam

engine and shafting, dynamos, &c., &c., at Charing Cross lighting station, together with cables and lamps on the Embankment, sundry other cables and dynamos in use, and a 20 H.P. semi-portable engine of Ransomes.

As regards the Jablochkoff light, we have more than once expressed ourselves favourably, and there is no question but that the candles have proved to be very practicable in operation, as for example, in the Thames Embankment installation.

There is also but little reason to doubt the statement so often put forth to the effect that there is a very considerable profit to be made on the sale of the candles alone. Supposing one penny profit per candle can be made it will be easily seen that the number of candles a twenty-light machine would use up in the course of a year would produce a very good profit, indeed so good that the company working such a business should be able to afford to supply the machines almost at cost price for the sake of the extra consumption of the candles insured by so doing.

Say a Jablochkoff candle lasts two hours, and take the average number of hours per night as six, we thus get a consumption of three candles per night. Now 365 nights multiplied by three, multiplied by the number of lights per machine, say 20, equal 21,900 candles, which number at 1d. profit per candle gives a total profit for candles per twenty-light machine of £91 5s. per annum.

Now even supposing that this is taking too favourable a view of the business to be done, and that the profit from this source is rather less than that above stated, still with the exceptionally good reference of several years lighting of the Thames Embankment this business should be worth much more than the amount for which it is now offered.

If it is to fetch no more we are indeed sorry for both the shareholders and creditors, for we believe the liabilities amount to something like £17,000, therefore £8,200 will not go far towards paying them, indeed, we understand, it will only clear up that portion secured by mortgage, whilst the unsecured creditors will have but little—probably nothing—and the shareholders will have lost all they invested in the company.

THE NATIONAL CONFERENCE OF ELECTRICIANS, PHILADELPHIA.

(Reported specially for the "Electrical Review.")

(Continued from page 308.)

THE members of the conference reassembled on September 9th, at 3 p.m., Prof. Henry A. Rowland, President.

The PRESIDENT: I believe it is understood by all that the discussion itself is limited to the conferees, and the record of the discussion will be properly kept and published in an appropriate form, either by an appropriation of Congress or by other means. The first discussion in order is to be opened by Prof. Abbe, "On the Work of the U. S. Signal Service in relation to Atmospheric Electricity and Earth Currents."

Prof. ABBE: On behalf of the chief signal officer of the army we have the honour to bring before you a few questions relating to the work which has been done, and the possible future work in atmospheric electricity and earth currents throughout this country, and I will in the first place preface the questions themselves by a short historical statement of the manner in which the work has grown in our hands. It became necessary in 1880-81 to instruct a few observers in atmospheric electricity for observations to be made in the Arctic Regions in connection with the International Arctic Expedition. We also in 1881 began the instruction of a few observers, under the special supervision of Prof. John Trowbridge, of Harvard College, Cambridge, Mass., and Prof. Henry A. Rowland, of Baltimore, with a view to training the particular observers in an accurate system of observations, and as to the actual results thus far obtained by these two men, I need only say, that photographic records are being kept of the details of the work, and Messrs. Trowbridge and Rowland will be better able to speak of them. It was in our contemplation to make this a basis of an extended system of 40, 50, 100, or 150, or 1,000 stations throughout the country, reporting to us systematically, and daily giving us a map of the atmospheric and electric condition of the earth and atmosphere, and comparing that daily with the isothermal lines of the winds and other currents. While we were quietly pursuing a course which in a few years would perhaps lead to some results, the International Conference held a meeting in Paris last April, and resolved that they would look to us to gather up the statistics, annually, monthly, and daily, as we best could—the electrical statistics for the country, and make an annual report to the International Conference. That report, being transmitted to the Secretary of State and the Secretary of War, comes down to the signal office as an order for us to carry out this work; so that from a small beginning we have constantly continued to expand to a large work. A few months ago we issued circulars to a number of electricians of the country, and found practical electricians of the telegraphic and telephone companies heartily in accord with us in our desire to observe and map out the daily weather conditions. We have, therefore addressed to the Commission, and through the Commission to the Convention, a general letter, stating that the chief signal officer desires to obtain as many observers as possible of all the phenomena appertaining to or bearing upon electricity obtained daily, weekly, monthly, or in annual reports, as may be sent in. As indicating a part of the scheme that we have in hand, which is nothing less than covering the whole country with electric stations, memoranda have been submitted of a few questions—eight or ten questions—and printed copies of these have already been forwarded and are in your hands, and I will not detain you to read them. The president has suggested that before I take my seat that I move as a member of the conference committee, which I now do, That this communication from the chief signal officer be referred to an appropriate committee, to be reported upon within not less than three months' time.

The following are the questions submitted:—

1. What, if any, public records exist in the hands of the electric light, telegraph or telephone companies relative to earth currents and atmospheric or auroral or other influences?
2. What is the general experience on the east and west, north and north-east and north and south and other lines?
3. What records can be kept by managers of all lines without interfering with daily business?
4. What special observations can be made?
5. What special lines of telegraphic or telephonic lines can perhaps be wholly devoted, or during part of the day partially devoted, to the continuous record of the phenomenon?
6. Do, or can the noises and currents as observed on telephone and telegraph lines give information as to the location and future movement of thunderstorms, aurora, rain or cold wave?
7. Are observations on buried lines or those covered with metallic tubing specially desirable?
8. How can we best secure the best electric survey of the country, or a small portion of the country, and a general survey of a larger region?
9. What is practicable in the way of securing a daily map of the distribution of the atmospheric and terrestrial electrical currents?
10. Who will maintain self-recording electrometers?
11. Must it be done entirely at the Government's expense, or will the electric lines co-operate with us in this matter?

The PRESIDENT: Any further discussion on this matter is now in order.

Prof. Sir WILLIAM THOMSON: I think the kind of observation that is most important in regard to the so called earth currents should be uniform, and I will just venture to remark that in an arrangement for measuring the different potentials between any two points by means of high resistance galvanometers doing really the functions of electrometers, it is most important that we have an instrument which will stand the current through a wire which is greatly disturbed by the pulsations which the current produces in the earth plates. Now the practical suggestion I have to make is that those stations that can undertake to do the work of this kind should be provided with high-resistance galvanometers. I believe generally the requisite sensibility will be that the instruments have a resistance many times—hundreds of times, perhaps—greater than the resistance of the line. Instruments of that kind made as required, might be left in connection during all the time the telegraphic line is not in actual work. And thus through a very considerable number of hours in the day, even on busy lines, the indications of the conditions of the potential between many pairs of chosen points in a telegraphic system might be obtained, and in this way you could get a few facts as to the difference in tension in currents, which is the primary object of the investigation in this part of the research.

The question being on the motion to appoint a committee to report on these questions, it was agreed to.

The PRESIDENT: The number of the committee has not been mentioned. I suppose it has been left to the chairman. But, of course, one cannot appoint such a committee offhand, and I think the actual names had better be left until the future.

Prof. F. E. NIPHER, of Washington University, St. Louis, Mo.:—In reference to the suggestion which was made just now, I should like to have an additional point examined and that is, the effect which a large number of battery cells grounded at given points would have on the potential on that point. I think that if these examinations were to be made at each station that that matter would necessarily be examined first.

The PRESIDENT: The next subject in order and one of the most important brought before the convention, is the adoption of the International Electric Standards.

[The International Conference for determining the electrical units which suspended its labours in October, 1882, resumed

them at Paris in the month of April last, under the presidency of M. Jules Ferry. The Conference unanimously adopted a series of resolutions, the objects of which are to define with precision various electrical measures whose determination is of great importance to science and industry, at the same time it expressed a desire that these definitions might be regarded as having the force of International Law. The resolutions were published in the ELECTRICAL REVIEW for May 10th, 1884.]

Prof. TROWBRIDGE: In regard to these resolutions, Mr. Chairman, I can only say that I think we can discuss at least two of them. The ohm has been fixed by all countries except the United States. It has been decided upon that the legal ohm represents one single millimetre section of mercury 106 centimetres long. I think that subject removed from all discussion, because that standard has already been adopted by every country participating in this Convention at Paris, except ourselves. The 3rd resolution is this:—The Conference recommends the construction of primary standards. I think that that resolution should be referred to a committee which has in charge the establishment of the Bureau of Physical Measurements or of Electrical Units. The 4th resolution is, it seems to me, beyond discussion also. The ampère has been adopted by all countries. And the volt is the electromotive force sustained in a conductor whose resistance is the legal ohm. It seems to me that is also beyond discussion. The resolution in regard to electrical currents and lightning rods, it seems to me falls properly under the subject which Prof. Abbe has just presented to the Conference. The only point which I can see which we can discuss, perhaps, is the standard of light. You know that there are many opinions upon the subject. I therefore present these resolutions to the chairman, and would recommend that the adoption of these units be referred to a committee.

Prof. ROWLAND: I suppose the object of bringing them before the Conference is, that we may recommend Congress to take some action upon this matter. I suppose it would be well, perhaps, to take up these in order. For instance, to say 106 centimetres of mercury be legalised in the United States as the standard of resistance. The 106 centimetres do not represent exactly the results of experiments, 106¼ is more nearly the result, but the round number was thought desirable. Sir William Thomson is present, who took an active part in that Conference, and perhaps he has something to say.

Sir WILLIAM THOMSON: With pleasure I may say with reference to the choice of the number 106, rather than $106\frac{5}{10}$ or $106\frac{1}{4}$, that although I believe I express the general opinion of those who took part in the conference directly, when I say that it was considered that 106·2 was probably nearer the truth than 106, yet there were results of able men who were present in the conference, and who had made careful experiments, which actually went on the other side of the 106. I do not remember exactly the figures, but some of the results went by as much as $\frac{1}{10}$, some by as much as $\frac{2}{10}$ below the 106. Under the circumstances, although I believe if the conference had been forced to vote decimally there would have been a force or expression of opinion—each person to vote for the decimal that he considered nearest to the truth, and that if members voted in this way the conference would have come to the 106·2. I have no right to say this as a result; but my opinion of the opinion expressed, and of the weight of the comments given by different observers, is that most persons present thought that the nearest decimal was 106·2. And that 106·2 was properly within $\frac{1}{10}$ per cent. of the truth. Yet they unanimously agreed to adopt 106. First, because we felt quite certain that 106 was the nearest unit if it expressed nothing more; second, because we felt confident that 106 was very near the truth, and therefore that 106 was a good approximation for practical purposes, It was also pointed out that the adoption of 106 as the legal ohm would not be a practically inconvenient resolution affecting the year 1884, and as many years after as it might be persisted in. Even if ultimately, as a result of more complete investigation, investigations by a greater number of competent observers, and observations more absolutely secure from all questions as to accuracy which may yet remain, even though such extended observation might give a difference of from one to three units or tenths of a unit, still the adoption of 106 as the legal standard at present would not cause serious inconvenience. I may add that the number 106 we felt confident would be accepted as probably the nearest unit on this side of the Atlantic, considering the very important observations Prof. Rowland had made. Prof. Rowland's experiments lay within $\frac{5}{10}$ per cent. of 106. They lay on the side below, not on the side above 106. We understood that he had made more experiments, and that those would be forthcoming in time. We only regretted that we were not able to put his last and best results into the balance, but we were so far happy that we were sure from what he had done, and from what we understood the experiments were, that 106, if taken as the number, would altogether satisfy Prof. Rowland on this side of the Atlantic.

The PRESIDENT: The experiments to which Sir William Thomson refers are not yet quite completed, and yet they have been completed to a certain extent, and I will call upon Mr. A. L. Kimball to give the last results that have been obtained upon this subject. I believe the number to which Sir William Thomson refers was for some years most accurate; but, of course, being scientific men, we are willing to make corrections if we believe another number will give a more accurate result.

Mr. A. L. KIMBALL, Associate Professor Physics, Johns Hopkins University, Baltimore, Md.: I would state that the first method that was employed in determining the resistance was the same as that employed by Professor Rowland in his experiments in 1876. A modification of Kirchoff's method, by which induction was produced by reversal of the primary current. We have made this year a good many experiments with a set of coils constructed on purpose. The result obtained thus far is the most satisfactory as the one which satisfies the observations best considered solely from their internal evidence. It is that one British Association unit is 0·9864 of the absolute unit. That is the value of the British Association unit as we find it in absolute measure. Experiments have also been carried on under the same preparation for the determination of the value of the specific resistance of mercury. We find, as a specific resistance of mercury in absolute units, a number which indicated that the absolute unit of resistance will be a column of one single millimetre in section, and 106·278 centimetres in length. This result, as will be seen, agrees very closely with the results obtained by Lord Rayleigh and Mr. Glazebrook in their experiments which they carried on, and we feel confident it is accurate to within about one part in three thousand. There are some experiments which have been conducted by the method of Lorenz, the reductions of which are not quite complete. That is to say, they have not been reduced to absolute measure, but the reductions have so far progressed that we say the extreme error between the greatest and least value obtained by that method is less than part in one thousand. That is the extreme difference between the greatest and least observations.

Sir WILLIAM THOMSON: Having taken part in the Paris Conference, I might be allowed to add one word, and that is, the members of the Paris Conference were quite ready to admit that what is now the legal ohm should be employed, and should cease to be the legal ohm when there is sufficient reason from experiments to make the change. So that the adoption of the legal ohm just now is, after all, only provisional. I think if we had had such a result as Professor Rowland has given us, the opinion of the conference would have been modified so as to adopt 106·2. I think the feeling was to make the legal ohm $106\frac{1}{4}$, and 106·2 would have been settled upon if they had had Professor Rowland's results. I do not think that the result would show that 106·2 was not practically convenient. It would be well to look forward a few years hence, and a few years will quite suffice to re-open the resolution, and to adopt the legal ohm which may be as surely within one tenth per cent. of the truth, as 106 is within one-sixth per cent. of the truth. I think that this work of Prof. Rowland, when he shall have entirely finished it, may be fairly accepted within a few years hence, and that we may know within one-tenth per cent. of what this important quantity is.

Professor JOHN TROWBRIDGE: I should like to move that the commission be authorised to take the proper steps towards legalising the ohm in this country according to the recommendations of the Paris Conference.

This motion was seconded by several members, and being on the motion was agreed to.

Prof. TROWBRIDGE: I should like to move also that the unit of current, the ampere, shall also be referred to the commission, who may take proper steps to legalise this unit.

This motion was seconded by Prof. BRACKETT.

The question being on the adoption of this motion, it was agreed to.

Prof. TROWBRIDGE: I would also move that the commission be authorised to take the proper steps to secure the legalisation of the unit of electromotive force called the volt. I don't know whether it can be legalised; it might be recognised. I don't think that that is the proper term. I move that it be referred to the commission for its final adoption.

The PRESIDENT: Final recognition, perhaps.

Prof. TROWBRIDGE: Recognition by the Government. I presume what the Government can do in this matter is simply to say what those terms shall mean. That those terms shall mean so and so.

The question being on the motion referring the volt for adoption by the Government, it was agreed to.

Prof. TROWBRIDGE: In regard to lightning rods, this resolution reads: "It is desirable that the results of observations taken by various officers be sent over to the International Telegraphic Bureau, at Berne, which will prepare a statement thereof and communicate to the Government. I would like to move that the resolution be referred to the same committee to whom the resolutions of Prof. Abbe were referred. It seems to me that it belongs to the signal service essentially, and that the committee recommended by Prof. Abbe is the best committee to discuss and take the proper steps for the adoption of this resolution. I therefore move that this resolution be referred to the committee which was proposed by Prof. Abbe.

This resolution was seconded by Prof. GIBBS, and was agreed to.

The PRESIDENT: The next question is in regard to the standard of light. I suppose that this will occasion more discussion than anything we have hitherto had. There is considerable objection in the minds of many to such a standard as platinum which has just melted and is just about to solidify. Has anybody any motion to make in respect to it?

Prof. TROWBRIDGE: Mr. President, I should like to move that this resolution on the standard of light be referred to a committee. There is a great difference of opinion upon this unit of light, and very many don't see how it can become a practical standard; although a late modification by Mr. Werner Siemens seems to me to make a very reasonable standard of it. Mr. Siemens takes the point of fusion of a platinum strip instead of

the point of solidification, and he passes the electric current through this strip of platinum, and regulates the current until the very moment he wishes to measure the light emitted, and then he measures it through a small conical opening with certain restrictions. I do not know of anyone who has actually tried this experiment with the exception of Siemens. He obtains in that way, if I can trust my memory, the light of $1\frac{5}{10}$ of a candle, and he uses that as a practical standard. It seems to be only one of the results adopted by the Paris Conference which we can practically discuss. Therefore I move that it be referred to a committee to bring the discussion before us, and who will so frame their resolutions that the discussion shall not be a desultory one, but be more or less systematic. I add to my motion that this committee be nominated by the chairman, and be announced at the next meeting to be held, and also say when the discussion will be opened.

Mr. N. S. KEITH, Secretary of the American Institute of Electrical Engineers, 237, Broadway, New York: As a member of the Board of Examiners entrusted with the duty of measuring the light of the electric lamps in the exhibition, I am very desirous of hearing at this stage of the proceedings, or as speedily as possible, an expression of opinion, as wide as it may be, not perhaps so much for final action in this matter as for the guidance of this Board of Examiners. We have already had a little discussion upon the point. Our deliberations, our measurements, and our actual performances will certainly be regulated very much by such an expression of opinion. Therefore, I do hope, without now being prepared to make an amendment to the motion, that the committee will so report that we will have a short discussion, and in the course of the present sitting of the conference.

CLEVELAND ABBE: I put as an amendment to the motion made a few minutes ago, "That the committee on light make a preliminary report to this Association at this session, and that this be made to apply to all committees, that they make a report at this session."

This motion was seconded by Mr. N. S. KEITH.

The question being on the amendment to the motion, it was agreed to.

The PRESIDENT: The motion then stands that this question be referred to a committee to report; to make a preliminary report at the present session of this conference. Who shall they report to hereafter, as we understand there is only to be one meeting of this Conference? I don't understand it.

Mr. N. S. KEITH: So far as the amendment is concerned, they are to report to this Conference; so far as the original motion is concerned, it does not state to whom they shall report.

Prof. TROWBRIDGE: Perhaps I was not definite enough in my resolution or in my remarks. What I really mean is this—what I really wish to accomplish is this—that three months from now, or at a suitable interval, that there shall be an adjourned meeting of this commission, we will say in Washington, where all the results we may gather from this exhibition on the subject of the standard of light, or dynamo-electrical machines, or electrical machines in general, that all these results and the results of the several committees shall be presented to the executive committee of this commission in Washington, and that the preliminary discussions shall take place here this week. That the discussions on the standard of light shall be opened by the proper committee at any time which the chairman may appoint, but that the preliminary discussion shall take place at this meeting of the Convention. I desire principally to secure an adjourned meeting where all these results can be carefully sifted. My motion was that a committee be appointed to take measures to bring the subject of the standard of light before this commission at this present sitting, that is to-morrow or the next day, and to open the discussion by some sort of report upon what has actually been done, and that then we have a discussion, and after the discussion is finished, that the committee shall report to the executive committee three months from the adjournment now—we will say at Washington.

The question being on the motion of Prof. Trowbridge it was agreed to.

The PRESIDENT: It is very desirable that persons who are practically engaged in the measurement of electric light should be chosen upon this committee. The question is purely a practical one; it has very little scientific interest, because I suppose scientists will get some standard of light which they can use for their purpose if they need anything but relative measures. Therefore it is very desirable that practical men should be upon this committee.

Mr. W. H. PREECE, F.R.S., being called upon by the President, spoke as follows: From disturbance of my brain through the excessive heat, I find it somewhat difficult to bring before you a new point or a new question. I wish to have it referred to one of the committees already appointed, or a new committee. It is the question of the consideration of the adoption of a new unit of power. I propose that the subject of the adoption of the watt as the unit of power, or unit of rate of working, shall be referred to one of these committees. But I want to go still further. The watt is a unit that connects together all practicable applications of science wherever energy is expended in any shape or form—the rate at which it is expended can be expressed by this watt. Hitherto, for the same purpose, we have used a most absurd unit, called a horse-power, which is not a horse-power. Watt himself determined that the amount of work done by a good average horse was something like 22,000 foot-pounds raised one foot high per minute, but he did not like the look of 22,000 foot-pounds, and he thought it was too small, so he added 50 per cent., and made it 33,000 foot-pounds raised one foot high per minute. Hence the horse-power, as at present used, means absolutely nothing; and if you have to convert the work done in an arc lamp or in a dynamo machine to horse power you have to use an awkward coefficient—746. Now I have spoken with a great many practical engineers, some of the most eminent mechanical engineers, and they all assure me that there would be very little practical difficulty in raising the value of the horse power, but if we were to make the present horse-power equivalent to 1,000 watts, it would mean that we would raise in its present value about 34 per cent., and we should then have a true unit. We might still call it a horse power, but we should have a unit that would be connected directly with the absolute standard of measurement, C.G.S. system, to which reference has been made. Therefore I beg to propose that the committee be instructed to consider the subject. First, that a watt be adopted as an authoritative unit of power; and, second, that the value of the horse power shall be increased to 1,000 watts.

The question being on the motion, it was agreed to.

NOTES.

Electric Lighting.—The Royal Courts of Justice were to be re-opened on Friday, the 24th inst., but the electric light was not ready for use on that day. It had been expected that the new machinery for generating the current, in course of erection under the Central Hall, would be completed in time, and consequently the entire plant previously in use was disposed of and removed by the Office of Works; but it was afterwards discovered that it would be impossible to set the new machinery in motion until some weeks had elapsed after the re-opening of the Courts, so that the Central Hall, the various courts and the corridors were to be lighted by candles and temporary lamps.

The Metropolitan Asylums Board is again advertising for tenders for lighting by electricity the three hospital ships now moored in the River Thames at Long Reach, near Dartford, and the Administrative buildings on shore. The specification has been prepared by Dr. J. Hopkinson, F.R.S., at whose office, 4, Westminster Chambers, Victoria Street, further information may be obtained. The tenders are to be sent in by November 11th.

The manufacture of electric headlights for locomotives has been commenced by the American Locomotive Electric Headlight Company at Akron.

The Broadway Tabernacle in New York is now lighted by electricity.

Mr. Killingworth Hedges, C.E., writing to the *Times* anent the recent explosion at Bermondsey, condemns the reprehensible practice of searching for faults in gas pipes with a naked light, advocating instead the use of a lather of soap brushed over the pipes, when the formation of soap bubbles would betray leakages. He further says:—The electric light, if introduced under proper supervision, will remove the great danger of fire and explosion which is connected with the use of gas and mineral oil, in that any risk of this kind will be localised to the electric supply station, where the dynamos and steam motors would be under skilled control. A general system of distribution is all that is required to enable the houses of the rich to be lighted by electricity and to be independent of any dangerous illuminant; but, as the late Sir William Siemens truly observed, "Gas will always be the poor man's friend," and in order that it may be employed with safety, a knowledge of its terrible power should be widely disseminated.

Mr. Charles C. McCarthy has made his first experiment in Belfast by fitting up the establishment in High Street belonging to Mr. H. Johnston with the electric light. The installation consists of 20 incandescent lamps (the new Oppermann patent) of 20 C.P. each, worked by an Oppermann dynamo, running at 1,350 revolutions per minute. The motive power is a two-horse Clerk's gas engine, connected by a counter-shaft with the dynamo. The 20 lamps work at their full brilliancy and with perfect steadiness, giving such

satisfaction that it has been determined to permanently continue their use.

In the Court of Session last week, before Lord Kinnear, an action was brought by the Jablochkoff Electric Light and Power Company against Messrs. Howard and Wyndham, proprietors and managers of the Edinburgh Lyceum Theatre, to recover the sum of £1,732 5s. 4d., the amount said to be due for supplying and fitting up machinery, &c., for lighting the theatre with the electric light. After hearing evidence, including that of Sir William Thomson, who said that he would not have accepted the installation for a single evening, his lordship thought the defenders were entitled to reject the installation as defective.

Mr. Charles Lever, of Bowdon, Cheshire, has just completed an installation of six of his own 2,000-C.P. arc lamps at the mill of Messrs. Blackburn & Co., Cleckheaton, where the work of spinning coloured goods is carried on. A special Gramme machine is used to work the lights, and is driven from the main shafting by a separate countershaft.

The lighthouse at the Hell Gate entrance of New York Harbour was illuminated by electricity on Monday night on the Brush system, nine lamps being used of 6,000-candle power each.

Messrs. Richards have just completed the lighting arrangements at their new works at Broadheath, using three Gramme dynamos for working 21 Lever arc lights, besides one exciting machine, and a small "Phœnix" machine for working 30 Swan incandescent lights which are used in the store rooms, offices, and dining room. In the fitting shops there are 14 arc lights of 2,000-candle power each, placed so as to avoid any shadows. In the foundry are placed six arc lights, and one in the yard. The different circuits of the lamps in the workshop, offices, and foundry are driven by three separate engines of small power, so as to enable them to be worked only as required. The plant has been erected by Mr. Charles Lever, of Bowdon, and so far the results are extremely satisfactory, both in working and as compared with gas.

The new ss. *Arawa*, belonging to the Shaw, Savill and Albion Company, and built at Dumbarton by Messrs. William Denny and Bros., was sent down the Clyde on her trial trip last week. She is the largest vessel hitherto built at the famous Lever works, and is fitted throughout with the electric light, the installation consisting of 300 Swan lamps fed by two separate sets of Ferranti slow-speed ship plant, to minimise the chances of a breakdown. The wires, lamps, and switches were all fitted up by the builders' electrical staff, under Mr. Smillie; while the Ferranti plant was made and fitted by the Hammond Electric Light Company, the specifications and official tests for the lighting being carried out by Mr. Jamieson, Principal of the Glasgow College of Science and Arts.

A Colonial Government and Telephones.—Mr. Berry, when acting as Postmaster-General of Victoria, submitted to the Cabinet the question of the Government taking over the telephone system from the company which introduced it. No decision was arrived at, and it has now been determined, the *Colonies and India* informs us, to allow the subject to stand over indefinitely. The Melbourne Telephone Company is not favourable to the idea of transferring its property to the State.

Telephony in Queensland.—The length of wire in use for telephonic purposes in Queensland is about 275 miles. The Brisbane exchange numbers 222 subscribers; Maryborough, 57; Townsville (opened in November, 1883), 42; Rockampton (opened in April last), 31.

Regulating Long Distance Telephony.—The royal decree for the regulation of the "long distance" telephone service in Belgium has been published in the *Moniteur Belge*.

Telephonic Communication between Towns in Belgium.—The Belgian Bell Telephone Company has announced the inauguration at the beginning of this week of public telephonic communication between Brussels and Antwerp, and has stated that almost immediately Charleroi, Ghent, Verviers, Liége, Louvain, and Mons will be connected in the same way. The charge is to be 1 fr. for five minutes' conversation, and 1 fr. 50 c. for 10 minutes, the maximum period allowed to each person. At night the charges will be double.

The Telephone in New Zealand.—In the latter part of 1881 the Postal Telegraph authorities of New Zealand introduced the telephone into the colony, and with success, as the number of subscribers at the following exchanges shows:—Dunedin, 300; Auckland, 250; Christchurch, 186; Wellington, 220; Invercargill, 40. "Bureau," a public call office, has been opened, and is much appreciated. The fact that no special skill is required on the part of the person in charge of a telephone, as in the case of a telegraph operator, has led to a large proportion of the country post offices being connected, settlers in sparsely-populated districts thus having the means of communicating with other parts of the colony to an extent they would not otherwise have possessed. In order to encourage private residence connections, the exchanges have recently been kept open all night.

The National Telephone Convention.—The sixth annual meeting of the National Telephone Exchange Association was opened in the Continental Hotel, at Philadelphia, on the 16th ult. Nearly one hundred active and honorary members, representing 34 distinct telephone companies, were present. The cities represented included every notable business centre from Maine to California. In the absence of the President, Vice-President Eckert, of New York City, called the Association to order. At the afternoon session the report of the committee on legislation was read by the chairman, William H. Eckert, of New York. The report dealt in the main with the restrictive legislation passed in the several States against the telephone "monopolies." A bill, recently introduced in the Ohio Legislature, compelling companies to place their wires underground, had not yet become a law, and in Delaware the Legislature had failed to pass a bill levying a tax of 10 cents. on every pole within the limits of the State, but in other States the telephone people had been far less successful in warding off restrictive legislation. The New York Legislature passed a bill, taking effect January 1, 1884, putting a tax of 2 per cent. on the gross receipts of telephone companies, while in Tennessee a recent bill levies a tax of 50 cents. on each connection. Other States have passed similar legislation. In St. Louis the use of the streets is prohibited, even after the passage of ordinances granting such privileges, except upon the agreement of the companies to file with the Controller on January 1 of each year a statement of their receipts, expenditures, profits, and general condition, and the payment into the City Treasury of 2½ per cent. of the gross receipts until 1890. After 1890 a tax of 5 per cent. will be exacted. In New Orleans $5 a pole is charged, and the city demands 10 free telephones for its exclusive use. In Pennsylvania the Legislature imposed a tax of $1 per pole, but no efforts have been made to enforce the law, and it may be contested. After the report had been read F. Drake, of Omaha, took the floor and protested against the publication of the facts contained in the paper. "These are matters," he said, "which the public have no right to know, and I contend that to give them publicity is to stand in our own light. To publish the facts concerning these restrictive laws is to set down a precedent for cities where prohibitory action has not been taken. Incited by the meddling of legislators in other cities, there would be no end of legislation tending to injure our business. I am opposed to this matter becoming public," C. N. Fay, of Chicago, defended the publication of all or part of the report as leading to a better understand-

ing between the public and the companies. H. L. Storke, of New York, said he had never heard of a company being crippled by restrictive legislation, and the public were entitled to know the laws of the several States governing the companies. John J. Sabin, of San Francisco, vigorously opposed giving the public information, but President Tyler said, and the meeting sustained his decision: "We are enjoying public franchises and privileges, and we have no right to hide from the public anything that it is entitled to know. The greatest publicity will work us the greatest good." A. Berthon explained the operation of the Parisian company of which he is superintendent. In France, he said, the telephone had reached a high state of perfection. All the wires were run through the sewers. The principal apparatus used in Paris is that of the Edison system. Within five years, it is expected, the Government will purchase the plant of the telephone company and run it for its own profit. At least it reserves the right to do so. The report of W. D. Sargent, chairman of the committee on central office and exchange systems, gave interesting statistics concerning the development of the telephone business throughout the United States. In Baltimore the number of telephone connections have reached 1,450; New York, 4,210; Brooklyn, 1,846; Cincinnati, 2,238; Detroit, 1,700; and Albany, 1,102. The statistics of Philadelphia were not given. On the second day M. Berthon exhibited diagrams showing the duplex and multiplex telephone systems as used in France, and explained how the French metallic circuit avoids induction. The subterranean circuits in Paris, he said, are so successful because they are not "buried" in the American sense of the term. They are strung overhead in the sewers—chambers sometimes as large as to admit of four carriages to be driven abreast. His remarks were listened to attentively, and were warmly received. The next meeting will be held at Providence, R. I., on the second Tuesday in November, 1885.—*Electrical World.*

The New York and New Jersey Telephone Company.—The subscribers to this company's various exchanges number close upon 10,000, New York alone containing over 4,200, and Brooklyn 1,850.

Cable Notes.—A writer to the *Pall Mall Gazette* concludes a long article on "The British Coaling Stations," with several proposals; one being that a telegraphic cable should be laid down connecting West Africa and the Cape direct with England. He further urged that from the Cape cable communication should be established with India and Australia; that a cable should be laid to Bermuda; and that the telegraph stations where the cable touches ground should be placed within fortifications.

The Bennett-Mackay Cables.—The second cable was landed 200 yards east of the Oriental Hotel, Coney Island, last Saturday, amidst much demonstration.

Cable Scheme in Canada.—The superintendent of Canadian telegraphs is about to visit British Columbia in connection with the laying of a cable from Victoria, British Columbia, to Point Anglos, Washington territory, a distance of about 18 miles. A line is also, it is said, to be laid across the Saanic arm.

The Australian Cables.—Mr. J. C. Syme, of the *Melbourne Age*, writes to the *Times* endorsing the remarks of "J. H. H.," reproduced in our columns last week. He states that although the Press of Australia only expends £14,000 a-year in cable messages, in place of £20,000 in 1878, in consideration of a reduction of rates, the Australian Governments subsidised the companies to the extent of £30,000 annually.

Telegraph Revenue.—The receipts from April 1st to October 18th, 1884, amounted to £1,005,000; from April 1st to October 20th, 1883, they were only £1,000,000.

A West African Telegraph Cable.—The *Silvertown* sailed on Wednesday from the Thames with the second section of the telegraph cable by which it is proposed to connect the English settlements on the West Coast of Africa with this country and the Cape of Good Hope. In three capacious tanks, 55 ft. in diameter and 30 ft. deep, she bears, coiled in convenient lengths, about 1,200 miles of cable manufactured by her owners the India Rubber, Gutta Percha and Telegraph Works Company, Limited. The section forms barely more than half the load the ship is constructed to carry. She steams to Teneriffe, where the first section of the proposed West Coast route to the Cape Colony, the direct cable from Cadiz, at present ends. In the first place a short cable of 200 or 300 miles will be laid to the island of Lanzarot, another of the Canary group, and then after receiving information from the staff on board the company's cable-ship *International*, now engaged in taking soundings for the work in hand, the *Silvertown* will begin to pay out and lay the line to the French settlement of Dakar, in Senegal, and thence to the British port of Bathurst. From this port it is probable that before long a connection will be made with St. Jago, whence a short line already affords communication at St. Vincent with the Eastern and Brazilian Companies lines. Loops of the projected West African cable are marked on the sketch map of the route to join Bathurst with Bissao and Bulama and independently to link Bathurst with Freetown (Sierra Leone), and Freetown with Accra. The selection of the port or ports at which the cable shall touch in order to supply the wants of the Congo region remains to be made. A guarantee of traffic has already been obtained from the Portuguese Government, and landing rights have been granted by the Government of the Cape, and the company is now in negotiation with the Home Government with a view to obtaining a subvention for stations at Sierra Leone and on the Gold Coast.

Telegraphic Development in Great Britain.—Captain H. M. Hozier, Secretary to Lloyds' Committee, in pointing out to the Postmaster-General the necessity for telegraphic communication with Loch Eribol, in consequence of the increased number of vessels from America which now pass round the north coast of Scotland, compares the English telegraphic system unfavourably with that of other nations, and attributes the want of progress here to the fact that telegraphic communication is a Government monopoly; he suggests that licenses should be granted to private companies to institute communication at their own risk in districts to which the Government system has not been extended.

Telegraphic Facilities Wanted.—At the meeting of the Greenock Chamber of Commerce, last week, the question of increased telegraphic facilities for Greenock was discussed. One application, it was stated, had already been addressed to the Postmaster-General without effect. A proposal to forward another was unanimously agreed to, as the Chamber decidedly objected to Greenock being made a sub-office of Glasgow.

Telegraphy in Queensland.—The report of Mr. A. F. Matveieff, superintendent of electric telegraphs for the colony for the year 1883, shows that there were 6,797¾ miles of line and 10,936¾ miles of wire open for public business; 418 miles of line and 1,089½ miles of wire having been completed since the previous report. The expenditure in maintenance and repairs for the year was £5,956 7s. 4d.

Professor Morse.—Two interesting letters written by the late Prof. S. F. B. Morse have come to light, in which he describes his early struggles and ambitions regarding the telegraph. These were addressed to the late Judge William W. Boardman, of New Haven, then a Member of Congress and a warm friend and supporter of the inventor.

The Electric Lighting Act.—The *Standard*, in a leading article, says :—Some practical steps are, it is understood, being taken to rehabilitate the reputation of electric lighting. If electric lighting is to have a fresh start on a sound basis, it is contended that Mr. Chamberlain's Act must be repealed, and there is a strong *primâ-facie* case for this demand. The most important fact now established is that electric lighting will not take the world by storm, and dispossess our familiar methods of illumination as by the stroke of a magician's wand. Its peculiar advantages are unquestioned ; but the practical difficulties of its application are likely to remain for many years to come material obstacles to its general adoption. If it is ever to succeed it can only be by the slow and tedious process of development that has preceded the definitive establishment of nearly all other modern inventions. It is urged now, by men whose connection with electrical science is not merely financial, that the precautions taken two years ago to protect the public against the excesses of unpractical and unscrupulous speculators have destroyed the prospects of a beneficial invention. The Act, it is asserted, imposes obligations which could not possibly be undertaken by a young and precarious industry. It would be impossible, for example, to guarantee the supply of electricity to all who cared to ask for it, irrespective of pecuniary considerations, until the ramifications of a comprehensive installation were perfected. The Act seeks to prevent the creation of monopolies ; electricians contend that great centres of production are absolutely essential to economy. The Act takes measures to safeguard human life, and limits the current to be transmitted by any main. Electricians affirm that these precautions are excessive, that sub-division entails immense sacrifice, and human life might be reasonably protected with a less stringent enactment. The Act reserves to the consumer discretion as to the burner he employs ; electricians explain, and with some reason, that the apparatus is the essence of the invention, and the supply of electricity a subsidiary matter. Without expending unnecessary and undeserved commiseration on electricians in their present straits, we might reasonably acknowledge that the Act requires revision in a liberal sense. The question to consider is simply whether the electric light be worth having. If we reply in the affirmative, then we must be prepared to make some sacrifices to obtain it. Hitherto we have been led to expect the electric light for the price of gas, but that was a deception. We can as yet get no light equal to gas for the same money ; but we can get a much better light at a relatively less cost. Unless some entirely novel contrivance be found, street lighting by electricity must remain more expensive than gas. Even if we consented to pay more money for a better light, it is doubtful whether street lighting would be remunerative without house lighting ; and electricians maintain that the latter is at present impossible on any great scale, owing to the difficulties created by Mr. Chamberlain's Act.

The Electric News Company, Limited.—The subscribers to this company's system have been notified that its business has been taken over by the Exchange Telegraph Company, and that they are expected to give immediate instructions as to whether they wish their service continued or not. A very peremptory tone is adopted, and we understand that the rate to the subscribers is to be doubled. Surely such high handedness is not good business policy !

Professor Tyndall.—On Wednesday evening Prof. Tyndall delivered the inaugural address of the 62nd session of the Birkbeck Literary and Scientific Institution, describing, with the motive of encouraging the students whom he was addressing, the earlier years of his own life, during which, as a student, he displayed extraordinary application to study and devotion to duty under difficult circumstances ; the narration lost nothing in interest in that it was made by the subject of it.

Fatal Gas Explosion.—A gas explosion, attended with fatal consequences, occurred about 9.30 p.m. on Thursday, the 16th inst., at 28, Edward Street, Star Corner, Bermondsey. The house is one of a number of four-roomed tenements which abound in this thickly-populated neighbourhood, and contained three families. Throughout Thursday a smell of gas was noticed to be coming up through the floor of the front parlour, and in the evening it became so strong that Mrs. Jones went to the offices of the South Metropolitan Gas Company in Old Kent Road, and complained of the escape, and her urgent representations induced the officials to at once send two of their staff of workmen, Thomas Honey and James Woolger, to the house. Failing to find the leakage in the main that runs through the street, Honey went into the house with a piece of lighted tow. He stooped to trace with the light the place the gas was coming from, and the next instant a terrific explosion shook the building. The front and back walls of the house were blown outwards with great violence, and at the same instant the roof and flooring and partitions of the rooms fell, burying Mr. and Mrs. Jones and three children, Mr. and Mrs. Watkins, and Honey, the gas man, in the *débris*. Several lads who had been watching the operations of the gas men, and three or four persons who were passing at the time, were hurled to the ground by the falling bricks and the force of the concussion, and most of them were found in an unconscious state, with blood flowing copiously from the head and face. When the *débris* was removed, considerable time having elapsed, it was found that one of the children, William Jones, was severely hurt by the pressure ; he died from internal hæmorrhage soon after being admitted into Guy's Hospital. The other two children were in a state of collapse when rescued, and one sustained so serious a fracture of the skull that it was found necessary to perform the operation of trepanning.

An explosion of gas, causing much damage, occurred at the Jewish Synagogue, Spitalfields, on Wednesday evening, and was followed by a fire, which, however, was soon subdued.

Bursting of a Gas Engine.—On Monday afternoon, at the premises in Cannon Street which are being transformed into the engine house in connection with the Inner Circle District Railway, a powerful gas engine, provided to ventilate the tunnel running alongside, and attended by John Callan, exploded. Callan was found seriously injured, and was removed to St. Bartholomew's Hospital. On examination it was found that both his legs were fractured. Two other men received slight wounds. The damage done to property is comparatively slight. We learn that the engine which exploded was not one of the "Otto" make.

Electricity as a Motive Power.—Joseph V. Meigs, in a communication to the New York *Sun*, makes the following criticism upon the use of dynamos for railway purposes :—There is a difficulty which has not been met, and must be met, to make the application of this wonderful transmissible power useful where steam now is. The locomotive—the steam engine—has exactly the same power developed on the crank from the cylinder at one revolution a minute that it has at 2,800 revolutions, were that possible. The dynamo requires 2,800 revolutions a minute to develop its power. At one revolution a minute the dynamo has no power. Then, to move trains by a dynamo, this 2,800 revolutions must be reduced to one revolution. It cannot be done with economy by any well-known means, such as gearing or belting. If a slow running dynamo, which had the power applied as they apply it in a rotary manner, *i.e.*, without cranks, could be made, that would be a boon indeed to mankind, and you would not hear of successful trials without an immediate adoption. The cost of transfers of power from a great speed to a low speed will prohibit the general use of electricity as a motor, where cost is a consideration, until a slow running machine is discovered.

Ocean Depths.—As it is of interest in connection with submarine telegraphy, we give the following extract from the address of General Sir J. H. Lefroy, R.A., F.R.S., President of the Geographical Section of the British Association, Montreal meeting :—"There are few particulars in which the best atlases of the present day differ more from those published 25 years ago, than in the information they give us respecting the submerged portions of the globe. The British Islands, with the 50 and 100-fathom lines of soundings drawn round them, seem to bear a different relation to each other and to the Continent than they did before. The geography of the bed of the ocean is scarcely less interesting than that of the continents, or less important to a knowledge of terrestrial physics. Since the celebrated voyage of H.M.S. *Challenger*, no marine researches have been more fruitful of results than those of the *Talisman* and the *Dacia*. The first was employed last year by the French Government to examine the Atlantic coasts from Rochefort to Senegal, and to investigate the hydrography and natural history of the Cape Verde, Canary, and Azores archipelagos. The other ship, with her companion the *International*, was a private venture, with the commercial purpose of ascertaining the best line for a submarine telegraph from Spain to the Canaries. These two last made some 550 soundings, and discovered three shoals, one of them with less than 50 fathoms of water over it, between the continent of Africa and the islands. If we draw a circle passing through Cape Mogador, Teneriffe, and Funchal, its centre will mark very nearly this submarine elevation; the other two lie to the north of it. The *Talisman* found in mid-ocean but 1,640 fathoms, among soundings previously set down as over 2,000 fathoms. Our knowledge then of the bed of the Atlantic, and of the changes of depth it may be undergoing, is but in its infancy; and we have only to reflect what sort of orographic map of Europe we could hope to draw, by sounding lines dropped a hundred miles apart from the highest clouds, to be conscious of its imperfection. But this knowledge is accumulating, and whether revealing at one moment a profound abyss, or at another an unsuspected summit; marvels of life, form, and colour, or new and pregnant facts of distribution; it promises for a long time to come to furnish inexhaustible interest."

Scientists' Recommendations.—A writer in the *Electrician* of New York asks, "Why will practical and theoretical experts in electricity permit themselves to be used as scapegoats by recommending everything brought to their notice? Hardly a circular is sent out into the wide world announcing a new electrical article but the well-known names of prominent electricians, sometimes three or four in a batch, are published with their letters of commendation. It would seem as if these men of note in their professions were holding themselves too cheap." On first reading this paragraph we were inclined to ask, May not the same remarks be appropriately applied to "prominent electricians" on this side of the water? but the thought was, at once, followed by the consideration that only the *favourable* comments of experts are brought to the notice of the world, the *unfavourable* ones being kept unpublished.

Charge Against Directors.—The case brought by Mr. Hutton against Mr. Alfred Parrish and Mr. John Goddard, as directors of the Union Electric Light Company, for not having the name of the company displayed at the entrance to the registered office, was dismissed at the adjourned hearing on Wednesday, no evidence on the point complained of having been offered.

The Drawbaugh Suit.—The advocates engaged in this suit concluded their arguments on October 2nd, when Judge Wallace, as is usual in such cases, took the papers and reserved his decision, which may be withheld for a month or two.

The Electric Light for Use with the Microscope.—The scientists of the Franklin Institute recently made a series of experiments upon which will, in a measure, depend the future usefulness of the electric light for a variety of purposes. These experiments were especially devoted to determining whether the electric light can be made to burn steadily enough to be applied to uses to which its power makes it particularly applicable, but for which its flickering quality renders it of no value. The tests were made by means of a microscope and projecting lantern. The Drummond light has hitherto been used by the institute in illuminating objects deposited in the microscope. It has the merit of being remarkably steady, and is invaluable as a marine illuminator, but is not nearly so powerful as the electric light. The first experiment, states the *Electrician and Electrical Engineer* of New York, was made with a Brush electric focusing lamp. The microscope was placed immediately in front of the lamp, with its lenses ranged so as to throw the light in a disc upon a suspended screen. In this manner the throat of a fly and the leg of a spider were shown with great distinctness, the light being so steady as to allow a careful and most minute examination of the insect anatomy. The experiments were considered a success, as demonstrating that the arc light is capable of being made wonderfully steady.—[Similar tests to the above, it will be remembered, were recently made at the Crystal Palace with Gülcher's arc lamp.—EDS. ELEC. REV.]

Electrical Proof of Death.—The *Medical and Surgical Reporter* says—"When electricity, or rather its application in medicine, came in vogue, it was first thought that it would be a means of deciding whether a person was dead or not. This assumption was based upon the fact of electro-muscular contraction. But experience soon proved that for one to three hours after death has taken place, and in some cases where rigidity but slowly ensues for a still longer period, the muscles of a dead individual respond as well to the electric stimulus as those of the living being. Dr. Max Buch now publishes a modification of the above, and what promises to be reliable and scientific proof of death, for thus far no scientific test existed. While in the living the temperature of the surface over a muscle in the act of or immediately after contraction decidedly increases, this increase is utterly wanting in the dead, and even during the time (one-half to three hours) in which after death the muscle still retains its contractibility. Having placed, therefore, a surface thermometer on the skin, and having waited until the temperature has continued at one and the same height for about five minutes, the muscle just below the bulb of the thermometer is made to contract by electric irritation. If then the column of mercury does not rapidly ascend, we have the most definite and the scientific proof that life is extinct in the body; while if the temperature increases, it is just as certain that there is still life. Under normal condition, the skin for a considerable distance increases by several degrees in temperature if in the muscle below is caused a powerful electrical contraction; and this phenomenon is also observed in paralysed limbs; while in the dead nerves the production of heat, as induced by motion, has for ever ceased."

Scientific Lecture.—Prof. Steggall, of Dundee University College, is giving a course of lectures to the Alyth Literary Association, on "Electric Lighting." Prof. Steggall in his first lecture gave an approximate calculation of the cost of electric light produced either by means of a battery or a coal or gas engine, and also the cost of gas light compared with the electric light, arriving at the conclusion that, for domestic purposes at least, electric lighting, by reason of so many breakages, &c., being at present almost inseparable from its production and contrivance, was by far the dearer light.

The Duplex System of Telegraphy in Australia.—In January last a wire between Brisbane and Rockhampton was duplexed, and has worked satisfactorily ever since; there are also duplex lines between Brisbane and Sydney, and between Brisbane and Bowen, giving but little trouble. It is to be considered whether the quadruplex system may not be worked between Brisbane and Sydney.

Transfer of Business.—Messrs. J. E. Spagnoletti and Crookes, having purchased the business of Messrs. Griffith & Co., of Reading, have removed to Uxbridge Road, London. In addition to the manufacture of all kinds of railway telegraph instruments, they manufacture Barnett's secondary battery, and are also prepared to fulfil any description of electric lighting.

On a New Electromotor depending on the Oxidation of Carbon in the Cold.—By A. Bartoli and G. Papasogli.—The electromotive force of retort coke as against gold or platinum in potash or soda-lye is equal to 0·06 up to 0·17 D., that of Ceylonese graphite rather lower; in solutions of the carbonates of potash or soda 0·10—0·17 D.; in hypochlorite of soda, which does not attack retort coke directly, but only in the closed circuit, at temperatures between 14—100° C., 0·18—0·27 D., on returning to 14° C. it is 0·18° D. again. The same holds good with Ceylonese graphite. Other carbons conduct badly, and are attacked by the hyperchlorates (hypochlorites ?). If mixed with equal parts of Ceylon graphite and moulded into cylinders with asphalt they have, in solutions of hypochlorites of potash or soda, the electromotive force of 0·1—0·2 D.—*Gazzetta Chimica Italiana.*

Description of a Column with an Automatic Arrangement for Renewing the Liquid.—By M. Estève.—Estève's column consists of six elements along with a separate recipient for the liquid (bichromate of potash). The cell of each element is of a rectangular form, and a lead pipe leads from the bottom of one to the upper part of the next. The first cell is double, connected with the closed reservoir for the fluid; by the influx tube at the bottom end and by a kind of safety-tube passing from the upper part of the reservoir, and which is closed by the liquid in the first element if the influx is too strong.—*La Nature.*

A Galvanic Element with Direct or Indirect Action.—O. P. Niezeraux.—Plates coated on one side with sheets of caoutchouc are made into flat boxes by bending the caoutchouc up over the edge. These boxes are then filled with peroxide of lead, or with the same substance previously reduced. The boxes are covered with perforated plates, held in their places with slips of caoutchouc, and are placed opposite to each other in acidified water. Or the boxes may be filled with lead amalgam, which is oxidised by a current on the one hand and reduced on the other.—*Zeitschrift f. Instrumentenkunde.*

On Certain Electric Properties of Coral.—By G. Fae.—Coral conducts electricity with polarisation at common temperatures, the specific resistance being about $800 \cdot 10^6$ (mercury = 1). With increasing temperature the maximum conductivity is reached between 20°—40° C., declining again afterwards, and becoming null between 80°—100° C. The corresponding temperatures differ in different specimens. Repeated heating gives a lower temperature for the maximum conductivity, and a lower conductivity at equal temperatures. Prolonged heating, if only to 27°, reduces the conductivity to nil. The editor of *Wiedemann's Beiblätter* asks whether these phenomena are not due to occluded water which is driven off. Coral is diamagnetic.—*Wiedemann's Beiblätter and Atti della Soc. Veneto-Trentina di Sc. Natur.*

On a Method for the very Rapid Measurement of Great Potential Differences.—By R. Arnoux.—The points at which the potential differences are to be measured are connected with the two coatings of a condenser with intercalation of a Deprez and D'Arsonval galvanometer (a wire coil suspended from silver wires between two magnetic poles), and the first deflection is read off by means of a mirror. The condenser may have different capacities, according to the magnitude of the potential difference and the degree of accuracy required. The conductive wires must be very thin, not coated over and well insulated, in order that their capacity may be neglected.—*Wiedemann's Beiblätter.*

On the Amalgamation of Aluminium and Iron.—By. M. Krouchkoll.—If mercury in a glass is covered over with water slightly acidulated, into which is plunged an aluminium wire, and if the mercury and the wire are connected with the negative pole of a battery of two Daniells whilst a platinum plate immersed in the water is connected with the positive pole, the surfaces of the wire and of the mercury are deoxidised by the hydrogen gas evolved. If the wire is then plunged down into the mercury it becomes moistened, which did not take place previously, and is amalgamated. On exposure to the air the surface becomes dull, flocks of alumina appear and separate from the wire. Iron may be amalgamated in the same manner, and in time the mercury rises up along the immersed wire.

On the Distribution of the Potential in a Liquid Mass of the Form of an Infinite Rectangular Prism.—By MM. Appell and Chervet.—M. Chervet describes, in the first place, a modification of the capillary electrometer, which he uses in his experiments. He takes a L shaped glass tube, expanded above so as to form a vessel, and with a conical point, and introduces it with its horizontal end into a second similar vessel filled with dilute sulphuric acid, into which mercury is poured below, whilst the electrode passes out at the lower end. The vessel at the top of the tube is filled with mercury, and contains the second electrode. The change of level occasioned by an electromotive force is compensated by pressure, which is read off on a sloping water-manometer. With this apparatus the author has measured in two points the potential difference between two parts of a very flat rectangular trough filled with solution of sulphate of copper. Through this trough is passed a current by means of two cylindrical copper electrodes, immersed at the extremities of one of the short sides. One of these two electrodes is immersed in the middle of one of the short sides of the trough, whilst the other is at any other arbitrarily selected part of the trough, determined by its distance from such short side, and from the longitudinal median line of the trough. A long, tall, rectangular trough is also used, and on passing the current through it longitudinally the potential difference is calculated and observed at two points arranged in a similar manner on the surface of the trough.—*Wiedemann's Beiblätter.*

NEW COMPANY REGISTERED.

British and Foreign Marine Inventions Company, Limited.—Capital £60,000 in £2 shares. Objects: To purchase from the Ocean Marine Syndicate, Limited, several patented inventions relating to marine signalling, sounding, &c., and including the letters patent, No. 1603, dated 17th January, 1884, granted to William Balch, for an apparatus for sounding at sea by electricity. Signatories (with one share each)—N. W. Chittenden, 7 and 8, Church Passage, Chancery Lane; Alexander McKinnon, 70, Rotherfield Street; C. T. Dobson, 3, Rood Lane; Henry Bullock, 25, Villiers Street; E. G. Fellowes, Union Chambers, Wormwood

Street; Jasper Mason, Norgrove Buildings, Bishopsgate Street; A. Nuth, 20, Lady Somerset Road, N.W. The signatories are to appoint the first directors. Remuneration 100 guineas per annum to the chairman and 50 guineas per annum to each ordinary director. Registered, 18th inst., by Waterlow and Son, Great Winchester Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electric News Telegraph Company, Limited.—At an extraordinary general meeting of this company, held on the 23rd ult. at the offices, 4, Ludgate Circus, resolutions were passed approving the transfer of the undertaking and business of the company, with the wires, telegraphs, and other apparatus, together with the English letters patent, to the Exchange Telegraph Company, Limited, upon terms of an agreement dated 13th of August. An agreement between the company and Mr. William John Burnside, its managing director, was also adopted. Mr. Burnside resigns his position, the company agreeing to pay him all salary due, and a further sum equal to six months' salary, and also to assign him all its foreign patents. It was further resolved to wind up voluntarily, and Messrs. W. J. Burnside and Baker Philip Daniels were appointed liquidators. These resolutions were confirmed on the 7th inst. and registered 14th inst.

CITY NOTES, REPORTS, MEETINGS, &c.

The Telephone Company of Ireland, Limited.

ON Friday, the 17th inst., the fourth ordinary general half-yearly meeting of this Company was held in the office, Commercial Buildings, Mr James Winstanley, T. C., in the chair. The report of the Directors for the last six months, which has been already published, was submitted. For the following report we are indebted to the Dublin *Freeman's Journal*.

The Chairman said he regretted that the chairman of the company was not present. He had forwarded a letter, which the secretary would read.

Mr. James F. Butterworth, secretary, read the following letter:—

"Victoria Lodge, Francis Street, Victoria Street,
"London, S.W., October 16th, 1884.

"My Dear Sir,—I much regret that I am not sufficiently robust to attend the half-yearly meeting of the shareholders of the Telephone Company of Ireland to-morrow.

"However, when everything is going well, shareholders meetings are usually neither very numerously attended nor are those who attend them very anxious for elaborate discussion. This, I take it, is now the position of our company.

"We have a growing business, an increasing gross and net return. Adding together the dividends on their preference and ordinary shares, our original shareholders are receiving interest at the rate of 8 per cent. per annum, with a reasonable suspicion of a probability of an increase.

"The difficulties with the Post Office, which so long impeded our progress, have all been practically settled. I expected to have been able to lay the new licence before the present meeting. It has not yet, however, been returned by the Post Office, but I am assured that it will be in a few days.

"No real points of difference remain between the companies and the Department. Under the new arrangements our company will be free to develop its business. It will be its own fault if it does not do so with equal advantage to the public and to the shareholders.

"I think I am justified in offering my congratulations to the shareholders, and am sorry that on this occassion I cannot do so in person.—Yours faithfully,

"E. DWYER GRAY."

The Chairman said he had much pleasure in moving the adoption of the report, which stated the position of the company so fully and clearly that he had nothing to add. It would not be judicious to enter into fuller explanations until their licence should have been signed by the Postmaster-General. He expected it would have been done before now, but the Postmaster-General was from home and the licence had to be sent to him. The directors expected to receive it signed in a few days. They were making every preparation for the extension of the business of the company as soon as the licence shall have been signed. They had at considerable expense erected poles and wires to Kingstown in anticipation of obtaining a considerable number of customers there and adding to their revenues very much. At that moment the circuit to Kingstown was complete, and gentlemen wishing to speak round that circuit, which was 15 miles in extent, could do so after the meeting was over. It was not yet fixed where the exchange was to be, but at present anyone in Kingstown requiring a private wire could have it. They were not prepared, however, to deal with exchange customers until they had their licence. As soon as that was obtained a scale of prices would be fixed which he was sure would prove satisfactory to customers in Kingstown. The report declared the dividends of 5 and 6 per cent. to the preference shareholders, a few of the 6 per cent. shares remaining unconverted.

Mr. J. B. Morgan, representative of the United Telephone Company, London, said he had great pleasure in seconding the motion. He regretted that Mr. Gray, who had worked indefatigably for the development of the Telephone Company in Ireland, and also for the promotion of telephone interests in Great Britain, had not been there to say what he had so tersely written. The difficulties with the Post Office had been surmounted mainly by his influence and personal pluck. When they got their licence it would be seen that what had been done up to the present in the way of developing telephone work was mere child's play. The company had not had scope for efforts, and could hardly even be said to have been in its infancy. Under the new licence he did not see why they should not be able to talk to all the towns of England, while the English towns would be in communication with each other. The other day he spoke by telephone from Liverpool to London. Experiments had taken place between Liverpool, Manchester, and Bolton, round circuits of from 300 to 500 miles; and in the North the trunk lines between Glasgow and Edinburgh were being developed and extended. A line to Brighton was also under consideration, and it was even said that with sufficient insulation they would eventually be able to talk round the world, which was no doubt scientifically true. He was sure the future of the telephone was so vast that each year they would be more and more surprised by the progress made. That company had never been in a better position than it was at present. With regard to patent rights, they had fought and won. They held patents of all the telephones that would be of practical use, which was a source of great encouragement to them and would also be a source of immense profit.

The motion was unanimously passed.

The Chairman moved that a dividend for the six months ending 30th June last, at the rate of one per cent. per annum, on the ordinary share capital of the company be declared.

Mr. Arthur Dudgeon seconded the motion, which was agreed to.

Mr. Tickell asked was it intended to extend the telephone communication northwards in relation to Clontarf.

Mr. Dudgeon said that until the terms of the new licence were settled the directors would feel embarrassed about making any arrangements about extension; but they had it in contemplation to make an extension in the direction of Clontarf, and also to establish call offices in all the suburbs round Dublin.

Mr. Tickell: That would necessitate an extension of communication.

The Chairman: It would.

Mr. Tickell said he believed the business of the company could be very largely extended in the suburbs.

The Chairman: I may inform you that the directors are preparing a scheme of extension in various directions into different localities—but they didn't like to state this earlier in the proceedings, because it is desirable to complete the licence before anything is done, lest there should be any hitch. We want to make sure of our ground.

Mr. Morgan was then called to the chair.

Mr. Rossborough moved a vote of thanks to the chairman, Mr. Winstanley.

Mr. Tickell seconded the motion, which was unanimously agreed to.

The Chairman, in acknowledging the compliment, said nothing should be wanting on the part of his brother directors and himself to develop their business thoroughly. They had plenty of scope, and they had also plenty of money, so that they had nothing to do but to work.

Mr. Morgan said it was very desirable that all the shareholders should canvas on the part of the company.

The Chairman: Within the last six months we have got over 100 subscribers.

The proceedings then terminated.

The West India and Panama Telegraph Company, Limited.

THE fifteenth ordinary general meeting of this company was held at the City Terminus Hotel, Cannon Street, E.C., on Wednesday. Mr. C. W. Earle, the Chairman, presided, and there was a fair attendance of shareholders. The report of the directors, which was submitted to the meeting, was published in our last issue.

The Secretary, Mr. R. T. Brown, having read the notice convening the meeting, and the minutes of the previous general meeting having been read and confirmed,

The Chairman said the account for the half-year showed a falling off in the total receipts of £1,964. There was a reduction in the expenditure of £1,477; but the balance was smaller than in the corresponding period of last year by £487. But it must be borne in mind that they were comparing with a very prosperous time. The receipts for the corresponding half of last year were £6,000 better than that of the preceding half-year; and then, again, they were the best they ever had, so that he did not think this showed any very great reduction in the traffic, notwithstanding the depression the West Indies were passing through. It was also to be noted that there was a small item of £800 in last year's account, which was interest which did not appear this year, because the interest upon the reserve fund was invested with the reserve, as shown in the balance sheet. If that amount had appeared where similar credit appeared last year it would convert the comparison into a small profit instead of a small loss. With regard to the expenditure side of the account, the reduction was attributable entirely to some exceptional charges which appeared in the corresponding account last year. An item of expense was the mission to the West Indies; while there were some exceptional charges on this side which accounted for the comparison being in favour of this year. He did not think there was anything to be hoped for in the way of a reduction of the expenditure; every item was watched with the greatest care, and he did not see where any further saving could possibly be made. During the half-year they had had as many as twelve interruptions to their cables, but fortunately their system was almost entirely duplicated, so that those interruptions occasioned little loss of traffic. But there was a serious interruption to the British Guyana, the Demerara cable, which was not duplicated, and this affected the traffic for a time. There had also been an interruption to the Barbadoes cable, which affected their traffic for a short time; and then the connecting cable between Florida and Havana was simultaneously broken with the cables belonging to the International Ocean Company. That company employed their ship to repair those two cables, and there was a delay of perhaps 20 hours in communicating with the West Indies. The progress made in repairing the San Juan-Porto-Rico cable had been satisfactory; they had completed it from Porto-Rico to within 30 miles of Jamaica, and the ship was grappling for the other end near Jamaica. While at work there an interruption occurred on the other Porto-Rico cable, and she left the work she was on and repaired that very promply, the interruption lasting only five days. At the same time a cyclone swept over Jamaica, and blew or washed away the land lines between the northern landing-place and the town of Kingston. The result was shown in the falling off of 30 per cent. in the receipts for that fortnight. He was very glad to say, on the whole, however, that the traffic revenue this half-year was a little in excess of the last, notwithstanding that serious falling off. It was a matter of great satisfaction to them that they had been able to persuade the colonies of St. Lucia and Grenada to make the increase in their subsidies which was shown in the report. At a time like this, when everybody was disheartened about the commercial affairs of the country, it was very generous on the part of those two colonies to have given them that small increase. Looking back to what they found the state of the subsidy account when the present directors took office in 1874, they saw that the total nominal subsidy payable amounted to £16,800; this was very irregularly paid, because the lines were in a very unsatisfactory condition; and, in fact, he might say that in no year previous to 1874 did they receive more than a few hundred pounds. Since then the lines had been put in order, and the subsidies had been paid almost entirely. But they had been able to obtain from the colonies a total increase amounting to £7,800, bringing up the nominal subsidy account to £24,600. There were still the colonies of Barbadoes and the group of Leeward Islands, with the Island of St. Vincent, which adhered to their pound of flesh, and had not as yet granted them any increase. With regard to the foreign colonies, he did not expect to receive very much consideration from them. St. Thomas was in a very low financial condition, and perhaps it was as much as it could do to pay the £1,000 they now received. The subsidy had expired this year, and the company had applied for its renewal. The French colonies were in the same position with regard to the subsidies, and they had also been applied to, but they must wait to see what views they took of it. Unfortunately, there was not a very favourable state of feeling between France and England at this moment, and he would be deceiving them if he expressed himself very sanguine of getting from the French colonies more than they now received. Everyone would have noticed the increased amount of attention the West Indian colonies had received since they last met in that room. The commercial depression was very striking—sugar had fallen 50 per cent.; sugar imported a year ago and quoted at £1, had been down as low as 10s. 9d. on the 3rd of the present month. The deplorable change that heavy fall must make in the great industry of the colonies was very serious, and although they had not as yet apparently suffered very much from it, they must expect that the want of prosperity on the part of those whose business they carried on, must affect them more or less, and they felt very great sympathy with the sufferers in this extraordinary depression. Many suggestions had been made as to remedying it—countervailing duties, amalgamation with the United States of America, incorporation with Canada and other things had been suggested, but, of course, it was for the statesmen ruling this country to see whether there was any way out of the difficulties which threatened the West Indian possessions. There had also been a little stir about the defences of colonies; there were two ports in the West Indian region, the port of Kingston, Jamaica, and the port of St. Lucia, and these were both important coaling stations, and were likely to become more important when the Panama Canal is completed. Whether the attention of the Government would be turned to the strengthening of the defences of those places he did not know; if they did, one could not conceive that telegraphic communication with those colonies would not form a very large part of the elements for consideration. But they must wait and see what turned out, and all they had to do now was to try by the formation of sufficient, though not extravagant reserves, to keep up the position they occupied and, in association with the Government, endeavour to strengthen the colonies; and also, if possible, to improve the position of the long-suffering shareholders of that company. He moved the adoption of the report, and that, as recommended by the board, a payment of 6s. per share on account of arrears of dividend on the first preference shares be made.

Mr. Wm. Ford seconded.

Mr. Chaplain asked whether the Board considered it discreet to name the amount to which they proposed to raise the reserve fund. As a debenture holder, he should be perfectly satisfied if it reached £100,000.

Mr. Morton said he felt it was an injustice to the shareholders to keep increasing the reserve fund instead of paying dividends. The second preference shareholders wanted to know how long they were to wait before they would get any dividend at all; it was nearly five years since they had received anything. If the directors had been in the same position he would not mind, but he objected to pay £2,100 to directors and get nothing for it; they could not afford it. If they wanted the shareholders to suffer, they should suffer a little also. He was perfectly prepared to say that they earned their money; but it was not fair that they should deprive the preference shareholders of all return upon their investments.

The Chairman said it was difficult to say when they would think it necessary to cease adding to the reserve; there must always be a gradual contribution. Theirs was a very small reserve, when they considered that their property had cost them £1,250,000—smaller, in fact, than that of any other submarine telegraph company. He should be sorry to encourage any hope that that reserve fund would ever be divided to pay the second preference shareholders. It would be a very improper thing on the part of the directors to propose, and they would oppose the suggestion as strongly as possible. With regard to the directors' fees, that had been thrashed out so many times that he should hardly have thought it would crop up again. The directors of this company were invited to take its management when it had not paid one shilling dividend; they had worked strenuously on its behalf, and had raised it to the position which he had described; and now, the shareholders were perfectly at liberty to dismiss them, but as long as they continued to discharge the duties of their offices, they were entitled to their salaries. They found a most deplorable undertaking, not earning a half-penny, and it had caused them extreme anxiety and labour to carry it on to the comparatively small success to which they had been able to bring it.

Mr. Robinson Kendal pointed out that no such thing as the £97,000 reserve which Mr. Morton proposed to lay his hand upon existed on the balance sheet. There was a debenture debt which had first claim upon the company, which would leave only about £47,000. The accounts showed that the directors had given much valuable attention to the affairs of the company, and when they thought of the increase they had obtained in regard to the subsidies, of the general management, of the way in which the reserve of the company had been invested, they must admit that the directors were entitled to the thanks of the shareholders. The company had really barren ground to work upon; trade had been restricted and almost paralyzed by the great depression in the sugar market; and the commercial operations of the islands were in an almost destitute condition. The directors were not to be blamed for these things, nor for the want of fructification in the finances of the company. Without a reserve fund, he might say, the company would be in a very weak and unsatisfactory condition.

The resolution was then put and carried, and the meeting terminated.

The Brazilian Submarine Telegraph Company, Limited.

THE report of the directors for the half-year ended 30th June, 1884, is as follows:—The revenue for this period amounted to £76,794 17s. 6d., and the working expenses to £12,868 17s. 8d. After providing £838 14s. 9d. for income tax, there remains a balance of £63,087 5s. 1d.; to this is added £243 17s. 3d., brought forward from 31st December last, making a total of £63,331 2s. 4d. A quarterly interim dividend amounting to £19,500 has been paid, and £24,000 transferred to the reserve fund, leaving a balance of £19,831 2s. 4d.

The directors now recommend the declaration of a final dividend of 3s. per share, making a total payment of 6 per cent. for the year ended 20th June, 1884, and that the balance £331 2s. 4d. be carried forward to the next account.

The duplication of the company's entire system of cables between Lisbon and Pernambuco has been successfully completed at a total cost of £650,922 18s. 6d., of which £500,922 18s. 6d. has been taken from the reserve fund, and the balance, £150,000

has been provided by the issue of the company's Five per Cent. debentures for that sum.

Since the last meeting the 1874 cable between Madeira and St. Vincent has been interrupted at two points, one near the Canary Islands, and the other close to St. Vincent. The cable was repaired 32 days afterwards, but the interruption resulted in no inconvenience as the second cable was laid and working, thus preventing a serious loss of revenue to the company. The cable, which has been submerged ten years, was found in excellent condition both as regards the iron sheathing and the core. All the company's cables are now in good working order.

The Eastern Extension, Australasia and China Telegraph Company, Limited.—This company notifies that the coupon on its Five per Cent. debentures (1880 issue), due on the 1st of November, will be payable on and after that date on presentation of the same at the Consolidated Bank, 52, Threadneedle Street, E.C.

The Direct United States Cable Company, Limited.—The board has resolved upon the payment of an interim dividend of 5s. per share, being at the rate of 5 per cent. per annum for the quarter ending 30th September, 1884, such dividend to be payable on and after the 15th November next.

LATEST QUOTATIONS.

Authorised Issue.	Share.	Name.	Paid.	Closing Quotations, Oct. 23.	Business Done.
		ELECTRIC LIGHT.			
40,000	5	Anglo-American Brush Co.	5	1½ - 1⅞	
		Do. Do.	5	3 - 3½	
30,000	5	Australasian E. L., Power & Storage Co.	4	..	
24,000	10	British Insulite Co., Ld., "A" Shares..	6	..	
25,000	5	Gt. Western Electric Light & Power Co.	2½	⅜ - ½	
47,233	5	Hammond Elec. Lt. & Power Sply. Co.	5	¾ - 1	
40,000	5	Indian & Ori. Electl. Storage Wks. Co.	2½	..	
250,000	½	Maxim-Weston Elec. Lt. & Power Co. ..	½	½ - ¾	
40,000	5	Pilsen-Joel & Gen. Elec. Lt. Co.	5½	..	
20,000	5	S. African Brush Elec. Lt. & Power Co.	2½	..	
100,000	5	Swan United Electric Light Co., Ld.....	5	..	
		TELEGRAPHS.			
1,802,480*l.*	Stk.	Anglo-American, Limited	100	31 - 32	31½. 2
2,553,760*l.*	Stk.	Do. Pref. } Def. receiving no div. until	100	54 - 55	54⅝
2,553,760*l.*	Stk.	Do. Def. { 6 p. c. paid to Pref..... }	100	6⅞ - 7⅛	7⅛
130,000	10	Brazilian Submarine, Limited	10	11¼ - 11½	
150,000*l.*	100	Do. 5 per cent. Bonds.....	100	102 -104	
16,000	10	Cuba, Limited	10	11 - 11½	11 5/16
6,000	10	Do. 10 per cent. Preference ..	10	17 - 18	
13,000	10	Direct Spanish, Limited	9	3¾ - 4	
6,000	10	Do. 10 per cent. Preference ..	10	14½ - 15½	
65,000	20	Direct United States Cable, Ld., 1877 ..	20	10 - 10½	10¼
100,000*l.*	100	Do. 6 per cent. Deb., repayable 1884	100	..	
380,000	10	Eastern, Limited	10	11⅜ - 11½	11⅜
70,000	10	Do. 6 per cent. Preference.....	10	13½ - 13⅝	
200,000*l.*	100	Do. 5 do. Debs., repayable Aug. 1887	100	100 -103	101½. 2
200,000*l.*	100	Do. 5 do. do. Aug. 1899	100	104 -107	
500,000	Stk.	Do. 4 do. Debenture Stock	100	99 -100	
250,000	10	Eastern Exten., Australasia & China, L.	10	11⅜ - 12	11 15/16. 12. 11 13/16
320,000*l.*	100	Do. 6 p. c. Debs., repayable Feb. 1891	100	109 - 112	
640,000*l.*	100	Do. 5 p. c. (Aus. Gov. Sub.) Deb. 1900	100	103 - 106	103¾
100,000*l.*	100	Do. 5 per cent. Debenture, 1890	100	102 - 105	
550,000*l.*	100	{ Eastern & South African, Ld., 5 p. c. } Mort. Deb. Rg. redeemable 1 Jan. 1900 {	100	103 - 105	
22,050	10	German Union Telegraph & Trust, Ld.	10	9⅞ - 10¼	
250,000	10	Globe Telegraph & Trust, Ld.	10	6⅞ - 7¼	7¼
250,000	10	Do. 6 per cent. Preference	10	12⅜ - 12⅝	12⅜. 11/16
150,000	10	Great Northern	10	13⅜ - 13⅝	
100,000*l.*	100	Do. 5 per cent. Debentures ..	100	101 -104	
300,000*l.*	100	Do. 5 per cent. Debentures ..	100	103 -106	
81,200	10	India-Rubber, Gutta-Percha, & Tel. Wks.	10	22 - 23	22 15/16
100,000	100	Do. 6 per cent. Debs., 1886	100	101 -103	
18,000	25	Indo-European, Limited	25	32 - 33	
40,000	10	London Platino-Brazilian, Limited	10	3⅞ - 4¼	
100,000	100	Do. 6 per cent. Debentures	100	101 -103	
10,000	8	Reuter's, Limited	8	7⅞ - 8	
338,228*l.*	Stk.	Submarine	100	175 -180	179. 8
75,000	1	Do. Scrip	1	1⅞ - 2	
4,200	Cert.	Submarine Cables Trust	100	99 -102	
37,550	12	Telegraph Construction and Mainten.	12	34 - 35	34⅝. ¼. 4. ⅜
150,000	100	Do. 6 per cent. Bonds, 1889 ..	100	106 -109	
186,750	5	Do. 2nd Bonus Trust Cert. ..	2½	1⅛ - 1⅜	
30,000	10	West Coast of America, Limited	10	5⅜ - 6¼	
150,000*l.*	100	Do. 8 per cent. Debs.	100	112 -115	
45,181	15	Western and Brazilian, Limited	15	6⅞ - 7⅛	
24,729	7½	Do. Preferred	7½	4⅜ - 4⅝	
24,729	7½	Do. Deferred	7½	2⅜ - 2⅝	
200,000*l.*	100	Do. 6 p. c., Debs., "A," 1910 ..	100	103 -105	104. ⅜
250,000*l.*	100	Do. 6 p. c. Mort. Deb. B. '80, red. Feb. 1910	100	98 -100	
1,500	$1,000	Western Union 7 p. c. 1 Mort. (Bg.) Bds.	$1,000	123 -125	
1,650,000*l.*	100	Do. 6 per cent. Sterling Bonds	100	100 -103	
88,321	10	West India and Panama, Limited	10	⅞ - 1⅛	
34,563	10	Do. 6 per cent. 1st Preference	10	7⅞ - 8⅛	
4,669	10	Do. 6 do. 2nd do. ..	10	4¼ - 5¼	
		TELEPHONES.			
224,850	1	Con. Tele. & Mainten., L., Nos. to 154,163	1	7/16 - 9/16	
225,000	1	Oriental Tele. Co., Nos. 80,001 to 300,000	¼	⅛ - ⅜	
100,000	5	United Telephone Co.	5	12½ - 12¾	12¾. 7/16. ⅜. ½
20,000	5	Do. New, issued at £2 pm.	2	7⅛ - 7⅜	7⅜

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 10th, were £2,592; and for the week ending October 17th, were £2,301, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 15th October, are £1,679, as compared with £2,363 in the corresponding period of 1883.

The Brazilian Submarine Telegraph Company, Limited. The receipts for the week ended 10th October amounted to £2,376.

NEW PATENTS—1884.

13034. "Secondary batteries." A. PFANNKUCHE, Dated October 1.

13046. "Electro-dynamic and dynamo-electric machines." J. H. JOHNSON. (Communicated by A. de Meritens.) Dated October 1.

13067. "Dynamo-electric machines." L. J. GROVES. Dated October 2.

13088. "Telephonic and telegraphic apparatus." C. W. and J. L. CORBETT. Dated October 2.

13092. "Rotary electric batteries." A. C. HENDERSON. (Communicated by C. Bazin.) Dated October 2.

13096. "Stopping horses when running away or kicking by electric action." W. K. BROCK. Dated October 2.

13126. "Apparatus for lighting gas by electricity, applicable also for other electrical purposes." C. L. CLARKE, H. J. COATES. Dated October 3.

13133. "Manufacture of incandescence electric lamps and apparatus therefor." H. WATT. (Communicated by E. Weston.) Dated October 3.

13139. "Dyeing and printing animal or vegetable tissues and paper with colours derived from artificial alkaloids by electrolysis." A. C. HENDERSON. (Communicated by L. Aubert.) Dated October 3.

13162. "Dynamo-electric machines." G. SCARLETT. Dated October 4.

13174. "Electrical voltaic elements and means of operating same." T. ROWAN. Dated October 4.

13200. "Electric clock escapement." W. R. LAKE. (Communicated by J. Zimber.) Dated October 4.

13214. "Electrical joints." A. SWAN. Dated October 6.

13242. "Electric telephone transmitters." W. B. HALE. Dated October 7. (*Complete.*)

13266. "Printing telegraphs." W. P. THOMPSON. (Communicated by C. E. Burke.) Dated October 7. (*Complete.*)

13281. "Electro-magnetic apparatus." H. J. HADDAN. (Communicated by C. Cummings,) Dated October 7. (*Complete.*)

13324. "Electrical signalling apparatus." J. W. FLETCHER. Dated October 8.

13385. "Holders of electric lamps." C. H. GIMINGHAM, J. F. ALBRIGHT. Dated October 9.

13392. "Electric arc lamp." A. W. RICHARDSON. Dated October 10.

13513. "Arc electric lamps. J. H. JOHNSON. (Communicated by La Compagnie des Fouderies et Forges de L. Hormc.) Dated October 13.

13517. "Automatically controlling and regulating the motion or feed of carbons in electric arc lamps." C. BROWN. Dated October 13.

13521. "Galvanic batteries." C. W. HARRISON. Dated October 13.

13525. "Electric burglar alarms." H. H. LAKE. (Communicated by H. C. ROOME.) Dated October 13.

13543. "Checking machines for public telephones." J. J. MANN. Dated October 14.

13576. "Apparatus for suspending, raising, and lowering electric arc and incandescent lamps." T. H. HARRISON. Dated October 14.

13612. "Contact makers for electric tramcars." M. H. SMITH. Dated October 15.

13637. "Telegraphic translators." W. E. GEDGE. (Communicated by J. Kolzer.) Dated June 14.

13664. "Telephonic call apparatus." J. POOLE, K. MACIVER. Dated October 16.

13670. "Telephonic apparatus." J. STEPHEN. Dated October 16.

13682. "Art of telephony." J. M. MCINTYRE. Dated October 16.

13698. "Electrical conductors." T. J. HANDFORD, (Communicated by E. H. Johnson.) Dated October 16.

13718. "Alarm scare and stop lines." W. BURGESS. Dated October 16.

13735. "Communicating between residences or other buildings, and cab ranks or stands." M. LUMLEY. Dated October 17.

13744. "Primary or galvanic electric batteries and their construction." T. ROWAN. Dated October 17.

13752. "Secondary batteries partly applicable to primary batteries." G. G. André. Dated October 17. (*Complete.*)

13755. "Apparatus for telegraphing by means of reflected light." H. C. MANCE. Dated October 17.

13759. "Compound galvanic battery." S. H. EMMENS, UNITED PATENTS CORPORATION. Dated October 17.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1883.

5982. "Generation, storage, distribution, regulation and utilisation of electricity." J. S. WILLIAMS. Dated December 31. 2s. The object of this invention, the specification of which consists of 39 pages and is too lengthy to admit of an abstract, is to generate, store, distribute, regulate and utilise electric power for the operation of movable torpedoes, coast defence and marine operations, as well as for the operation of railways, tramways or other purposes, or any combination thereof, and it also relates to methods, apparatus and means employed therefor, or in combination with the improvements as described in former letters patents.

5983. "Generation, storage, distribution, regulation and utilisation of electricity." J. S. WILLIAMS. Dated December 31. 1s. 8d. The object of this invention is to render practical the application of the improvements, or some of them, described in the specification of former letters patent in combination with gas works or producers, for instance:—to convert coal and to separate or recover the products of combustion, viz., gaseous fuel, tar, benzole, ammonia, electric power as follows:—At such place where the coal is conveyed to, but preferably at the place where mixed the inventor establishes the converting or producing plant such as the ordinary system employed for the distillation of the coal and the distribution of gas. The main decomposing chamber is formed in somewhat the usual manner, and a thermo electric coil, or thermo electric elements, or series of them, are employed, which surround the decomposing chambers or channels for conveying the products of combustion. These elements are arranged to be in electrical communication with the electro chemical batteries or magazines compounded through the medium of commutators operated electro magnetically, thermo electrically, or by the shaft of a motor, or operated by a gas engine, the gas being exploded electrically and preferably from the electric magazine by time mechanism or otherwise, or the thermo electric circuit may be made direct to an electro gas magazine, in which provision is made for the decomposition of liquid solution, or the thermo electric circuit may be completed to compound induction or condensing devices through the medium of commutating or switching devices and compound electrical connections, or circuits, so as to form charging and discharging circuits. The inventor conducts current, or places the devices for recovering the charge from the thermo-electric elements in circuit or circuits, through the medium of the magazines, condensing or induction devices, or a combination of them, to which returns are made by earth, or the reverse, or by an insulated return circuit, and the working resistances throughout the system, such as the electrical magazines, lamps, heaters, motors, induction or condensing or other appliances, or a combination of them, can be connected, supplied and controlled in such circuits, in series or otherwise, in derived or loop circuits of multiple series, or parallel circuit, or in series, multiple series or parallel circuit in loops from the main circuit, and the devices be controlled individually or in groups in a system however extended, as for the operation of railways, tramways, canals, or for the storage of power at fixed points or stations, in or under any of the combinations or applications, as described in applications for patents of the same date as this application, as well as and especially the combinations, applications and improvements or parts thereof described in the specifications of certain former patents.

1884.

8962. "Improvements in receiving instruments for electric telegraphs." W. P. THOMSON. (Communicated from abroad by S. D. Field, of America.) Dated June 14. 6d. The object of this invention is to provide mechanical means for vibrating the tongue, lever, style, or other movable portion of a telegraphic receiving instrument by mechanical power, which is adapted to be controlled by the action of a feeble electric current upon an electro-magnet armature or needle, or by an alternate increment or decrement in the strength of a constant current. Fig. 1 represents the essential portions of the improved apparatus, and fig. 2 is a detailed view of a portion of the same. Referring to the drawing, A is the actuating electro-magnetic coil which is represented in the form of an ordinary electro-magnet, consisting of a soft-iron core having helices of insulated wire, the attractive force of the cores being exerted upon the soft-iron armature, *a*. Any other form of electro-magnetic apparatus adapted to the conditions of different lines or different systems of telegraphy may be used, such as a polarised electro-magnet or a movable coil vibrating in a constant magnetic field, or other equivalent devices for producing mechanical motion by the energy of an electric current. The movable lever, B, is pivotted at *b* to a stationary support and carries the armature, *a*, at or near its end. The drum or friction wheel, C, is mounted upon an axis, *c*, in such a position that its periphery is in the vicinity of the lever, B. A friction brake or shoe, D, is affixed to the lever, B, in a position as shown, so that the slightest movement of the armature, *a*, toward the poles of the electro-magnet, A, will bring it into frictional contact with the periphery of the drum, C. Upon the axis, *c*, of the drum, C, is fixed an endless spiral thread or worm, E, of considerable pitch which is engaged by a toothed wheel, F. The latter being driven by a grooved pulley, *f*, on the same axis. The last-named pulley is caused to revolve constantly in one direction by an endless belt, J, which is also conducted over and around a system of pulleys which will shortly be described. K is a pulley mounted upon an axis, *k*, turning in stationary bearings or supports over which passes a belt, cord, or chain, L, L, to the extremities of which are attached the axes of two movable pulleys, G and I. Another pulley, H, is mounted upon a sliding bar, *h*, movable to-and-fro in the direction of its length by means of a set screw, h^1, or other equivalent device. The belt, J, is driven by a constant motor not shown in the drawings, and moves continuously at a uniform rate of speed in the direction indicated by the arrows, passing first over the pulley, G, and thence over the pulley, *f*, and thence over pulley H, which serves to adjust the tension of the belt throughout the whole system as required, and thence a second time around the pulley, *f*, and thence over the pulley, I, after which it returns again to the motor. Upon the axis, *k*, of the pulley, K, is a toothed wheel or pinion, M, which engages with a rack, *m*, upon a piston rod or stem, *p*, of a piston, P, moving in a cylinder, O. N is a spiral spring, one end of which is secured by a clip at *n*, and the other to the axis, *k*, of the pulley, K. R is a second cylinder, similar to the cylinder O, but preferably of lesser diameter, within which moves the piston, *r*. The tube, Q, establishes a communication between the lower portion of the cylinder, O and R, and this is filled with a suitable liquid forming a hydraulic column

FIG. 2

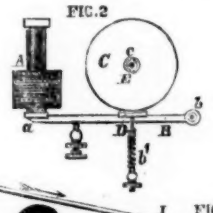
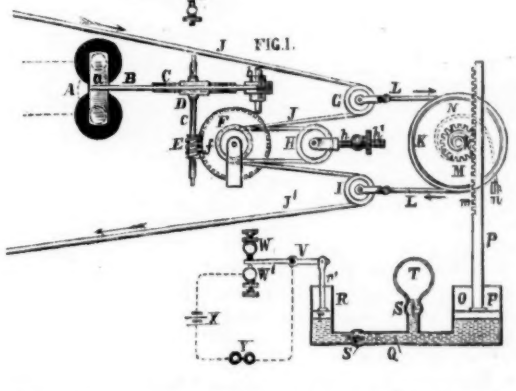


FIG. 1.



whereby motion communicated to the piston, P, will be transmitted to the piston, *r*. This tube may be fitted with a suitable cock-stop, S, for preventing such transmission when desired. T is a closed air chamber communicating internally with the tube, Q, by a passage which may be closed at will by means of a stop-cock, *s*. The piston rod or stem, r^1, is pivotted to a lever or tongue, V, which is capable of vibrating to-and-fro between stops or limiting screws, W and W^1, and may thus be made to alternately open and close the circuit of a local battery, X, containing a telegraphic apparatus, Y, of any desired construction. The operation of the apparatus is as follows:—The electro-magnetic coil, A, is included in the circuit of the line coming from the transmitting station. When no current is traversing the line the armature is drawn away from the magnet by the retractile force of the spring, b^1, and hence the shoe or brake, D, is not in contact with the periphery of the drum, G, and hence the latter revolves freely at a high rate of speed, being driven by the belt, J, as it passes over the pulley, *f*. So long as the drum, C, is free to revolve the difference in the tension of the belt, J, at the points where it passes over the pulleys G and I respectively, is not enough to overcome the resistance of the spring, N, so as to turn the pulley, K. If, however, the shoe, D, touches the periphery of the drum, C, a considerable mechanical resistance is offered thereby to the movement of the belt, J, the effect of which is to tighten it at J^1, and cause it to become more slack at J. The immediate result of this is to alter the relative position of the pulleys, G and I, thus causing the belt or chain, L, L, to move a short distance in the direction indicated by the arrows until the equilibrium is restored, after which they will remain in that position until the break-shoe, D, is withdrawn from the drum, C. This movement of the belt or chain, L, causes the pulley, K, and pinion, M, to revolve in opposition to the stress of the spring, N, thus forcing down the piston, P, and exerting a corresponding pressure within the tube, Q, tending to raise the piston, R, thereby bringing the lever, V, into contact with the stop, W^1, and producing a signal either directly or through the intermediate action of the battery so long as a current traverses the actuating electro-magnetic coil, A. When the current through the coil, A, ceases, the brake, D, is withdrawn from the drum, C, and the spring, N, restores the entire apparatus to its normal position. The function of the air-chamber, T, is to act as a spring or cushion for the hydraulic column, and thus prevent tremulous or uncertain contacts being made by the lever, V.

TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion must be authenticated by the name and address of the writer, not necessarily for publication, but as a guarantee of good faith.

Letters, &c., for the "Correspondence" columns should arrive not later than Tuesday morning if they are desired to appear in the following number, such communications to be addressed to the "Editors," ELECTRICAL REVIEW, 22, Paternoster Row, London, E.C.

Letters respecting Advertisements, Subscriptions, &c., should be sent to the "Publisher," ELECTRICAL REVIEW, at above address.

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CORRESPONDENCE.

The "Mechanic" Receiver.

Your publication of the text of the agreement between the United and the London and Globe Telephone Companies answers in part the query in my last letter.

What is now essential to those interested in the legal status of the "Mechanic" Receiver is information with respect to the patents for improvements in this instrument, formerly in the hands of the London and Globe Company, and now transferred to the United Telephone Company.

The numbers of these patents will probably be of service to others besides myself, as on their contents depends in great measure the question as to whether it is possible for anyone to make a commercially practical receiver on the "Mechanic" principle, which the United Telephone Company will not be able to claim as infringing their rights.

With respect to transmitters, it seems pretty clear that, according to the legal interpretation put on the Edison patent, the latter covers only the combination of a tension regulator with a tympanum or diaphragm, so that either of these may be used by itself without danger of infringement.

As a tension regulator must necessarily be employed, and as it is equally requisite that there should be some species of surface on which the sound-waves may be received, the whole question turns on the legal interpretation of the terms tympanum and diaphragm.

The opinion of Mr. W. C. Barney and any other of your correspondents who have the required information on this point will no doubt be of interest to your readers.

S.

Your correspondent "S," in the REVIEW of 18th inst., persists in denying my statement that the so-called "Mechanic Receiver" with diaphragm of parchment or of goldbeaters' skin was described in *Engineering* in September, 1876. I respectfully suggest to "S" that before he undertakes to deny the truth of a sworn statement made in a court of justice, upon which evidence I based my statement, he should carefully examine the document referred to, viz., *Engineering* of 15th September, 1876. As "it is never too late to mend," let him turn to page 242 of that journal of Sept. 15th, 1876, and he will there find the following words spoken by Sir William Thomson on 7th September, 1876, at the meeting of the British Association in Glasgow:—

. . . "All this my own ears heard, spoken to me with unmistakably distinctness by the thin circular disc armature of just such another electro-magnet as this which I hold in my hand."

The instrument held in Sir William's hand was the receiver well known under the name of the "Glasgow" receiver.

Sir William continued: "The words were shouted with a clear and loud voice by my colleague judge, Prof. Watson, at the far end of the line, holding his mouth close to a stretched membrane, such as you see before you here, carrying a little piece of soft iron, which was then made to perform in the neighbourhood of an electro-magnet in circuit with the line motions proportional to the sonorific motions of the air."

This instrument thus exhibited was the "Mechanic" receiver.

"S" will now probably admit that my statement as to the "Mechanic" receiver having been published in *Engineering* of 15th September, 1876, is correct, and that the *first* notice of Bell's original invention was on that date and not on 22nd December, 1876. In regard to the patent for improvements in the "Mechanic" receiver—formerly the property of the Globe Telephone Company, but now of the United Telephone Company—"S" can get the Patent No. 676, February 7th, 1883, granted to H. H. Eldred, at that time manager of the Globe Telephone Company; or he can turn to page 191 of ELECTRICAL REVIEW of September 8th, 1883, for my comments on those "*wonderful* improvements."

I refer "S" to ELECTRICAL REVIEW, December 1st, 1883, page 435.

W. C. Barney.

October 20th, 1884.

In reply to "S." I assume he refers to the case of the United Telephone Company *v.* Harrison, Cox-Walker, as the defendants in that case were indemnified by the London and Globe. It was intended to carry the case to the House of Lords, but the case has been settled, and the Globe Company amalgamated with the United. It would seem from this that the United are afraid of their patents.

Stat nominis umbra.

Electric Energy Recorder.

In reply to "Volta's" letter in your last issue, I beg to inform him that the material difference in the instruments does not so much consist in the fact that I have combined them so that they work with one cylinder, but also that I do not require multiple levers or any similar device, for obtaining a proper scale upon my diagrams. For obvious reasons, I shall not give your correspondent the details of construction whereby I dispense with the disadvantages attending the use of a long lever. He admits in his letter that his object is to endeavour to evade my patent, and I wonder how long the electrical world would have remained in ignorance of his inventive powers had you not published an account of my instrument. Has "Volta" ever heard the story of Christopher Columbus and the equilibrium of an egg? It is apparent that he has not read my claims in my patent, or he would not write so glibly of evading them.

When I appended my name to my letter I did not do so with any intention of posing as a "shining light," but simply because I was prepared to substantiate my assertions in a straightforward manner, and I do not consider that your valuable space should be further taken up, now that I have fully vindicated my claims. Therefore, for the future I shall treat your correspondent's anonymous insinuations with the indifference they merit, and am no longer surprised that he still prefers to veil such an avowedly discreditable transaction under a *nom de plume*.

Fredk. Walker.

36, Spondon Road, Tottenham,
October 20th, 1884.

[We think with Mr. Walker that this correspondence had better cease.—EDS. ELEC. REV.]

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